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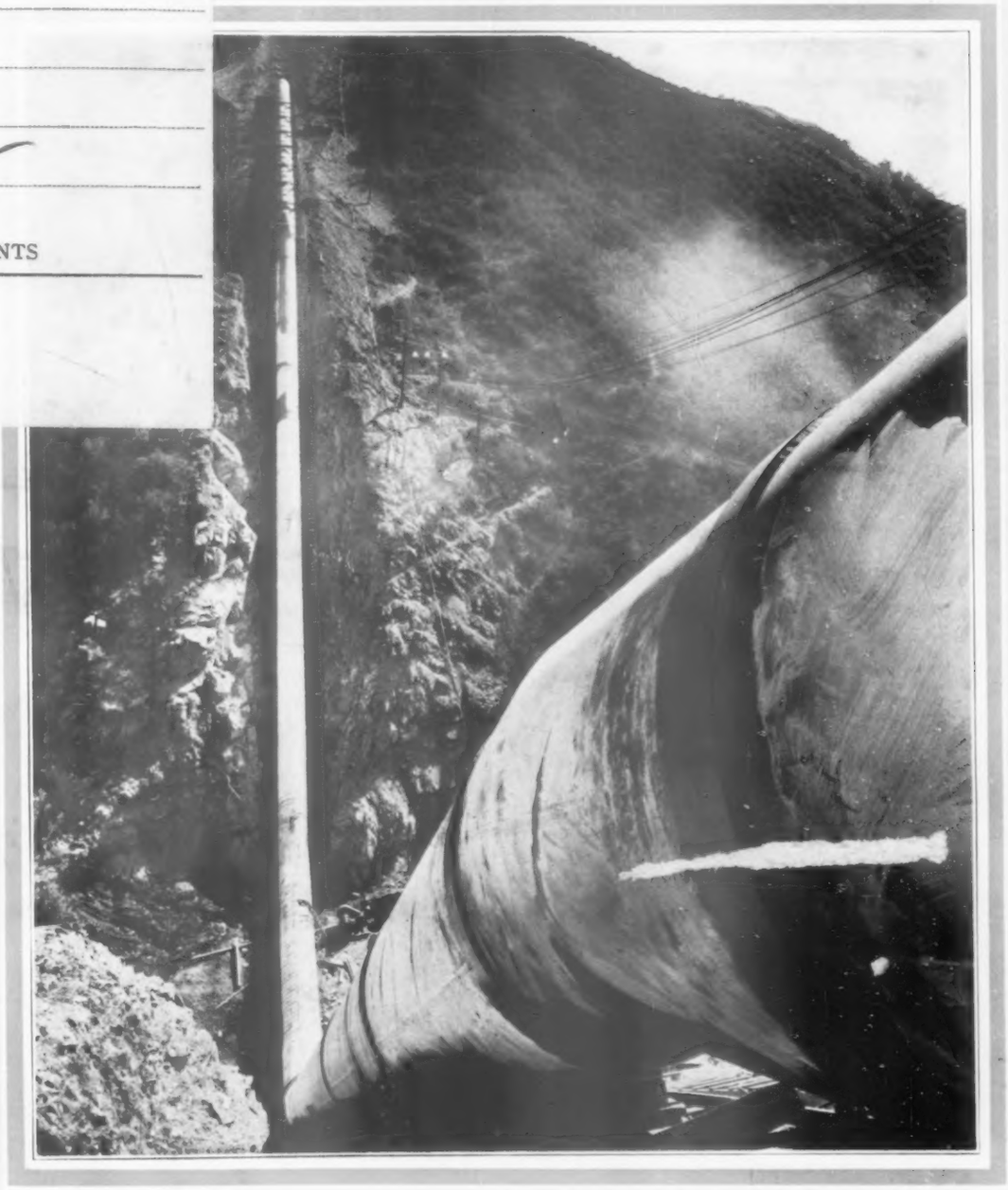

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(See Page 19

November-1933

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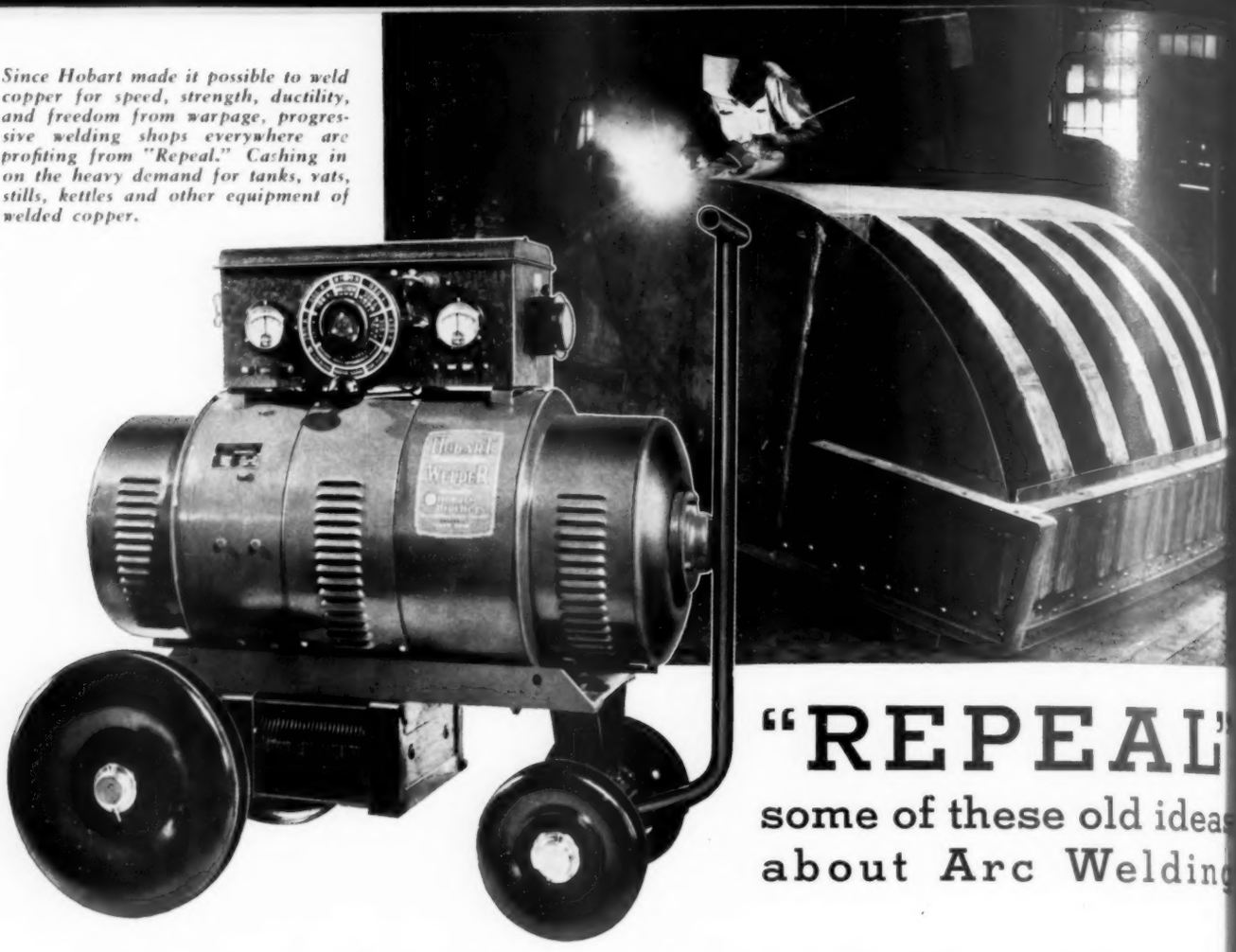

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THE WELDING ENGINEER

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NOVEMBER, 1933

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REPRESENTATIVES

EASTERN: T. E. Depew, 222 American Circle Bldg., New York, N. Y. Tel. Columbus 5-7843.
MIDWESTERN: L. C. Monroe, Room 2264, 608 S. Dearborn St., Chicago, Ill.
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A "Tip" to Coppersmiths

ON HEAVY COPPER WORK

for Breweries and Distilleries

Since the old days when you struggled with spelter or bronze welding rod on heavy copper work something important has been discovered—

Sil-Fos Brazing Alloy

U.S. PATENT 1,829,903

Last month we told you how SIL-FOS solved the problem of brazing a 15-foot scarfed seam in the ½ in. thick copper bottom of a 500 bbl. brew kettle built by Matt. Corcoran & Co. for the Frank Fehr Brewery of Louisville.

Earlier we also described the successful brazing of a still longer seam in ¾ in. copper plate by a Philadelphia coppersmith.

SIL-FOS is a patented alloy containing silver, phosphorus and copper. This unique combination gives it characteristics all its own:

1. Flows "like water" at 1300° F.; or several hundred degrees lower than temperatures required by other commercial hard solders.
2. Penetrates minute openings into which the more sluggish hard solders will not enter, making sound, homogeneous joints, usually testing stronger than the parts joined.
3. Requires NO FLUX in copper-to-copper brazing; and VERY LITTLE flux with other metals.

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· E D I T O R I A L ·

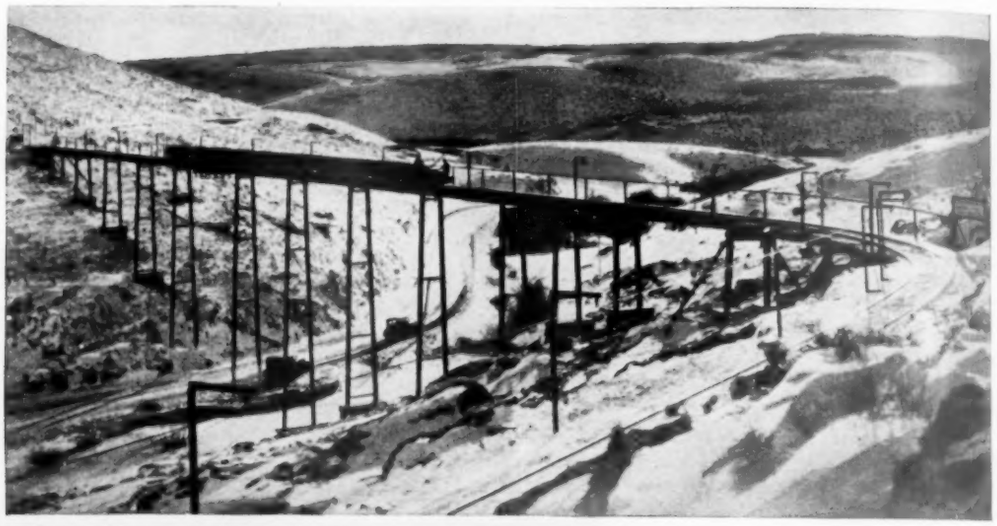
Criticism of Tests of Structural Joints

● What is the behavior of welded joints of loaded truss members? To what degree does the eccentricity of the section affect the joint? Despite all the laboratory research work that has been done on structural joints, reliable data on these questions are still very much lacking. The structural engineer is still skeptical about many of the comparative figures presented on efficiencies of riveted and welded joints, because the set-up under which such tests have been run is far from that met with in actual practice. If some laboratory, with the required facilities, would test angles, channels, and composite members employed as struts and diagonals, by using test specimens having a high slenderness ratio, the results would be of great value. ¶ The many laboratory tests made of welded structural joints have several serious drawbacks from the standpoint of the reliability of the data obtained. The tensile testing machine almost invariably will accommodate only specimens of short length. Hence, any eccentricity introduced into the specimen by the grip of the jaws while the specimen is being pulled may affect the result materially. This has resulted in the substitution of the pin-connected joint for the conventional rigid joint in such specimens, notwithstanding there are other factors that may introduce elements of eccentricity into the specimen greater than those caused by the rigid connection at the jaws. These other factors have to do with the dimensions and locations of the welds and the order in which the welding was done. In the case of an angle, for example, good construction demands that a fillet weld be placed on each side of the angle at the end joints, the ratio between the lengths of the two welds being such as to develop the effective section of the angle and have the resultant force in line with the center of gravity of that section. If the short welds are the first to be welded onto the end plates, and after they are cooled the long welds are put on, considerable eccentricity will be introduced into the angle due to expansion and contraction in welding and distortion occurs even before the specimen is put into the testing machine. It is supposed that the welds on test specimens are laid in such sequence that the locked-up stresses prior to welding are so small they can be ignored as having no effect on the test data, yet this detail of welding procedure should be known and considered in evaluating the data obtained. ¶ Such eccentricities create a tendency for the specimen to twist at its ends, and the pin-connected joints allow this twist to occur, which in turn allows the stresses to be redistributed in the specimen—a condition that could not occur with rigid joints. It should create no surprise if structural engineers are skeptical of such test data. In a specimen having a high slenderness ratio (for example, a 3x3 in. angle with a length of at least 15 ft.), the eccentricities produced by the welding operations and by the rigid grip of the jaws of the testing machine are small and they become of less consequence as the length of the specimen is increased. ¶ A word of caution should be given regarding the end plates used with test specimens. These plates are necessarily small, and hence they do not have the high rigidity of beams to which truss struts and diagonals are welded. In the laboratory the stresses met with in a tensile test often cause these plates to bend and buckle, creating an unduly high compression in the outstanding leg of the angle and increasing the tensile stress in the remainder of the angle section. ¶ A series of tests of welded joints using angles and channels of long lengths as specimens, with complete details given as to welding procedure, will aid very materially in inspiring confidence in welded structural design.

The Get-Together Spirit Will Help the Welding Shop

● In a certain mid-western city of 115,000 population, there has existed intense competition between two job welding shops, both of good repute. This competitive condition is not any different from that which has existed in many other American communities and between job shops even in different communities. In this particular case, however, each of the two shops owners believed that the other fellow was a menace to the welding trade and to the community in general and that a public hanging would not be too good for him. Such are the rancors that arise from intense competitive conditions. Recently the job welding shops in this city got together into a local group to cooperate in the formation of a Code of Fair Competition as outlined in the National Industrial Recovery Act. Both of these job shop owners joined this group, entered into discussion with other shops concerning competitive conditions, began to see each other in a better light and to understand one another's problems, with the result that each finally decided that the other fellow was not such a bad specimen of humanity after all. After these men had gotten together several times in the organization meetings, it happened that a job came up which each of whom was very anxious to obtain. Instead of indulging, however, in the low-price cut-throat methods that at times had characterized their tactics in the past, they came to a common agreement and put in a joint bid for the job. Before doing so, however, they compared the bids which they wished to make and found that there was only $5.00 difference between the two bids. They obtained the bid jointly and did the job together. Depending on local conditions, all welding shops cannot cooperate with one another to the full extent these shops did, but if local welders will get together on their common problems, they will find that through cooperation a spirit of friendliness will prevail which will work for the good of all concerned and the advancement of the welding art in general.

G-E Arc Welding
Solves Construction Problem
on New Bridge



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- Type W-85 for manganese welding

WHEN haulage costs for the No. 5 Mine of the Kemmerer Coal Company in Wyoming became prohibitive because of the distance from the producing veins to the tipple, it became necessary to provide a "short cut."

An accumulation of stock on hand, consisting of pipe and rails from closed-down mines, was available. This material, plus G-E arc welding, resulted in the bridge shown above—an economical solution of the problem. The bridge has a span of 393 feet and is 52 feet above the main-route highway between Kemmerer and Yellowstone National Park. Yet the only new metal required was 135 pounds of G-E Type F electrodes.

You can't find better electrodes for general-purpose welding than the G-E Type F. By all means, try some for your next job and find out for yourself how satisfactory they really are. The nearest G-E welding distributor will gladly give you a sample. Ask him, also, for our handy booklet, "G-E Welding Electrodes," GEA-1546A, or address General Electric, Dept. 6A-201, Schenectady, N. Y.

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The Welding Engineer

VOLUME 18 NOVEMBER, 1933 NUMBER 11

Hard-Facing and Fabrication *in the* Dredging Industry

By following the proper procedure in applying hard-facing materials, the welder can reclaim a great deal of worn equipment and can materially increase the life of such parts as pump housings, dragline buckets, pipe fittings, and dredge cutters, some of which are economically fabricated by torch-cutting shapes from steel plates and welding these together.

■ By DON LLEWELLYN
Air Reduction Sales Company

TEN years ago, hard-facing was unknown to the dredging industry. In fact, at that time the only applications of hard-facing were in the oil industry, which was just learning how the efficiency of drilling bits could be increased through its use. For several years thereafter the oil industry continued to absorb practically the entire output of hard metals. It was not until the depression came along that hard-metal manufacturers actively sought new fields and outlets for their products.

Many oil-field shop welders were compelled to leave because of lack of work. They entered other industries and applied their experience gained in hard-facing drilling bits to other equipment. In addition, many executives had heard stories of the possibilities of hard-facing. Driven to drastic economy, they investigated the advantages of using it on their own equipment. These factors, coupled with the efforts of hard-metal manufacturers and welding interests, soon brought hundreds of new and profitable hard-facing applications in many industries to light.

It required, of course, two or three years to introduce hard-facing properly to the steel, cement, brick, road-making, dredging and similar industries. All these and others have now learned that hard-facing properly selected and applied increases the life of their equipment very considerably and saves them many expensive shut-downs.

Fig. 1. Half-Section of Worn Pump Housing With Inside Walls Hard-Faced With Stoody Self-Hardening Rod Applied With the Arc.

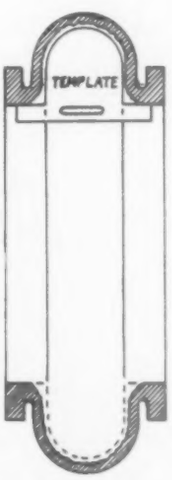


Fig. 2. Method of Reclaiming Worn Pump Housing.

Building-Up Dredge Pump Rotors and Housings

The dredging industry furnishes an outstanding example of the benefits which can be derived from hard-facing. Formerly, dredge pump rotors and housings were used until worn to the point that they became inefficient. They were then discarded and replaced with new ones at considerable cost. Now, however, many dredging companies salvage these pump rotors and housings by building up the worn areas with hard metal, and the reclaimed equipment frequently lasts twice as long as new equipment that has not been hard-faced. Hard-facing saves the worn-out equipment and most of the cost of new equipment.

A half-section of a worn pump housing is shown in Fig. 1, in which the inside walls have been overlayed with Stoody Self-Hardening rod, using the electric arc. The protection afforded can be readily seen.

The procedure recommended for reclaiming worn pump housings by hard-facing is illustrated in Fig. 2. A templet is made to fit the correct dimensions of the transverse radius and used as indi-

cated for determining the amount of wear inside the housing and as a guide in building it back to the proper contour. Stoody Self-Hardening Alloy Steel rods are being applied electrically with reverse polarity for this application. Skip welding is used and must progress at several different points of the circumference, never being continuous at one spot. This practice avoids heating the housing too much at any one section, which would tend to warp it.

Ordinarily, 3/16x28-in. rods are used. However, if time is an important factor, the new ¼-in. Stoody Self-Hardening rods, obtainable in 28-in. lengths bare or 14-in. lengths coated, should be employed, as they can be deposited at least 25% faster than the 3/16-in. size. The ¼-in. rod is specially suited to jobs requiring a large quantity of hard metal. As a rule, bare rods are used for all except the final layer of hard metal, for which the coated rods give a little smoother deposit. If no coated rods are available, the bare rods may be used for the entire job, however. Current used for the 3/16-in. rod is 150 to 200 amperes, and for the ¼-in. rod 250 to 350 amperes.

Cast-steel pump housings can be rebuilt with high-carbon steel rod, hard-faced with only one layer of Stoody

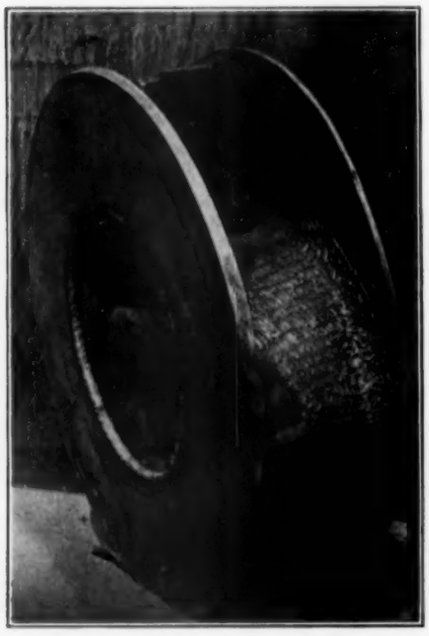


Fig. 3. Illustrating Application of Hard-Facing to Worn Pump Rotor.

Self-Hardening rod. High-manganese-steel pump housings, however, must be entirely rebuilt with Stoody Self-Hardening, no high-carbon steel rod being used. Hard metals are usually applied only to worn pump housings, as it would be a tremendous job to machine out the inner surfaces of new pump housings sufficiently to permit hard-facing. In some cases, however, new pump housings are designed for hard-facing and are

Fig. 4. Dredge Cutter With Detachable-Type Blades Hard-Faced.

cast with an inside diameter approximately 3/16 in. oversize to permit building up the inner surfaces with hard metal and bring them to their finished size.

Worn centrifugal dredge pump rotors are being rebuilt to size with Stoody Self-Hardening rod, and the rebuilt rotors have been found to last longer and hold their maximum efficiency better than new ones. Here, again, overheating and warping must be avoided. Hence, the electric process is favored. Welding must be carried on in several places as the job progresses, skipping from blade to blade to permit cooling and even distribution of heat. A pump rotor rebuilt in this manner is illustrated in Fig. 3.

Prolonging Life of Dredge Cutters

Dredge cutters of all types have been made to last two to five times longer by the application of hard metals to the blades. Stoody Self-Hardening, Stoodite, Silfram, Tube Borium of various screen sizes, and Borod have all been used for this application, being applied by either the oxyacetylene or electric process. All have been found to more than pay for themselves in extra service rendered.

At the present time, some contractors are using Electric Tube Borium because they find it will outwear other hard metals. Others, however, have found that Borod, applied either by the oxyacetylene torch or electric arc, gives better results because its deposit presents a more uniform structure in that it approaches a homogeneous matrix.

Electric or Acetylene Tube Borium deposits, on the other hand, are strictly heterogeneous in nature. In other words, the matrix of Tube Borium deposits is softer than the suspended Borium particles, while the matrix of Borod deposits contains so many extremely fine Borium particles that it seems solidly filled with them. Those who prefer Tube Borium contend that serrating, obtainable only by its use, provides better digging quality in certain formations, such as hard pan.

Hard-facing of manganese-steel cutter blades is not recommended, as a rule. Blades best suited for hard-facing are of steel containing not more than 0.45% carbon. Chrome-nickel or chrome-molybdenum steel blades are also hard-faced very successfully. Steel blades containing more than 0.45-0.50% carbon should be normalized or annealed after hard-facing to relieve stresses and prevent breakage. Worn-out cutter blades of detachable type are usually not worth reclaiming; only new ones should be hard-faced. Either the oxyacetylene or the electric process is used.

With oxyacetylene, the blades should be preheated to approximately 900°F. Warping or locked-up stresses must be avoided. Only the front side (inside) of the leading edge of the blades is hard-faced, as indicated in Fig. 4, with the heaviest applications at those points where greatest wear occurs. This gives them a self-sharpening quality and they stay sharp as long as any hard-facing remains on the blade. This is an outstanding advantage of hard-facing, as sharp blades dig better and require less power to drive. Plain, unfaced blades, on the other hand, soon become dull and inefficient in use, lose their digging

Fig. 5. Close-Up View of Detachable Blade Section, Showing Hard-Facing.

qualities, and require more and more power to drive until replacement becomes necessary.

The six-bladed dredge cutter shown in Fig. 4 has a cast-steel spider. The blade sections, which are detachable, were forged from scrap armor plate, hard-faced on the inside of the leading edge, as shown, and then riveted in place on the spider. Fig. 5 is a close-up view of one of the detachable blade sections, taken from inside the spider.

The spider type of cutter, illustrated in Fig. 6, is also well adapted to hard-

facing. The California contractor using this one has found that the best hard-facing materials obtainable pay him big dividends. A close-up view of one set of teeth, showing hard-facing of Borod applied on front (inside) and edges is

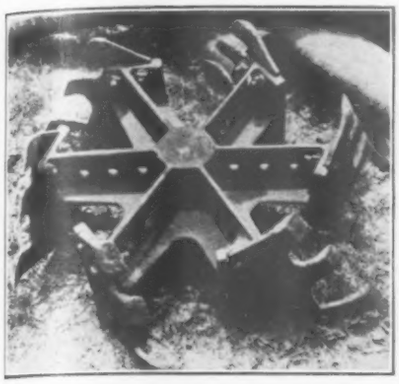


Fig. 6. Spider-Type Dredge Cutter Hard-Faced With Borod Applied With the Oxyacetylene Flame.

given in Fig. 7. The softer back (outside) or heel of the teeth wears away first, thus keeping the points sharp.

Fabricating Equipment From Torch-Cut Shapes

With the introduction of hard-facing to the dredging industry, a new method of making dredge cutters, frames, etc., also came into use. Many welders are so skilful with their cutting torches that they can fabricate complete cutter heads and blades from ordinary flat steel plate, thus entirely eliminating expensive castings otherwise required. The cut shapes are easily heated and bent as necessary to conform to the curves of the cutter head and frame. They are then welded together in sections.

The plate specified is usually plain carbon steel containing not more than 0.45% carbon, which meets all the requirements for strength and efficiency in

Fig. 7. Close-Up View of Teeth of Dredge Cutter.

most cases and is relatively inexpensive. Where great strength is essential, some of the better-known alloy steels such as chrome-molybdenum, chrome-vanadium, chrome-nickel or nickel steels may be specified. Any of these are easily welded and make good bases for hard-facing.

Most steel jobbers now own oxyacetylene cutting machines, and will take orders for any kind of steel, cut to any shape and of any size and thickness which the owner or operator of dredge equipment may require. It is only necessary to form these plates and weld them together to complete a fabricated dredge cutter head.

The importance of fabricated equipment should not be overlooked by anyone interested in dredging operations. Fabricated parts are lighter, stronger and less costly than castings. Furthermore, they may be made up within a very short time, whereas it often requires weeks to secure new castings, during which period an expensive shut-down may be incurred.

A fabricated dredge cutter head is illustrated in Fig. 8. The five blades were cut from steel plate, formed and welded together. Some of the welds are clearly visible. Unfortunately, the welder was unfamiliar with hard-facing technique and applied the overlay to the back side (outside) of the leading edge of the blades. Instead of being self-sharpening, the wear occurred bluntly on the front

Fig. 8. Dredge-Cutter Head Fabricated by Cutting and Welding.

(The blades were cut from plates by using the torch and were welded together. The hard-facing should have been applied on the inside of the blade edges instead of the outside.)

edge in service, dulling the cutter badly and in time necessitating its replacement.

Application of Hard-Facing to Drag-Line Buckets

Remarkable savings are obtained by hard-facing dragline buckets, both new and worn. Fig. 9 shows a new dragline bucket with teeth, lip and runners overlayed with Stoody Self-Hardening rod before being placed in service, for protection against excessive wear.

A worn dragline bucket, rebuilt and protected with hard metal, is shown in Fig. 10. It will outlast a new bucket several times. Fig. 11 illustrates the method of hard-facing the inside surface of the bucket lip to protect it against severe wear. Tube Borium, Borod or Stoodite could be applied on the teeth if the bucket is not to be used among large boulders or otherwise subjected to severe impacts. Where violent shocks are encountered, Stoody Self-Hardening rod or Silfram is recommended.

Shovel teeth of carbon or alloy steel, either forged or cast, are well suited for hard-facing and are economical. Fig. 12 shows a 0.35-0.45% carbon cast-steel tooth protected when new with Tube

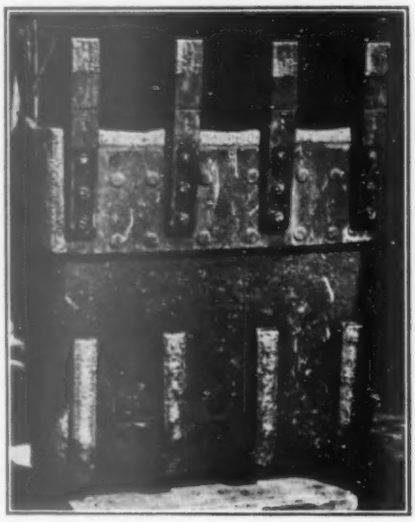


Fig. 9. New Dragline Bucket With Teeth, Lip and Runners Hard-Faced as Protection Against Wear.

Borium. Note how the tooth has remained sharp and efficient, even though it has already seen six times the service of plain, unfaced teeth. The rebuilding cost is low. It can be done with high-carbon steel rod hard-faced with Stoody Self-Hardening or Silfram if the tooth is to be used in rock formations. For digging in abrasive sand or soil, Tube Borium, Borod or Stoodite applied on

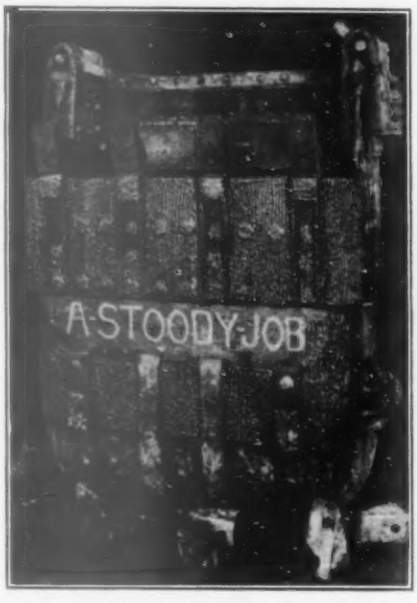


Fig. 10. Rebuilt and Protected With Hard Metal, This Old Dragline Bucket Will Outlast a New One.

the top side and edges is recommended.

Many other parts of dredging equipment may be hard-faced to advantage. For example, Fig. 13 shows a section of a forward shoe of a self-adjusting drag-head of the hopper dredge *U. S. Culebra,*

Portland, Oregon. Each shoe was hard-faced with 45 lb. of Stoodite applied electrically.

Cast-steel or cast manganese-steel pipe bends and elbows used on dredges wear badly on the inside of the outer radius, due to the abrasive action of sand and other suspended matter in the material

Fig. 11. Inside Surface of Dragline Bucket Lip Overlaid With Hard-Facing.

Fig. 12. Cast Steel Shovel Tooth Hard-Faced With Tube Borium.

handled. They are reclaimed by building up the worn area, or protected when new, with Stoody Self-Hardening rod, applied electrically. The welder should not continue in one spot on this work, but skip around to several different points as the job progresses, to avoid warping or breakage.

To those familiar with the dredging industry and the extremely severe usage

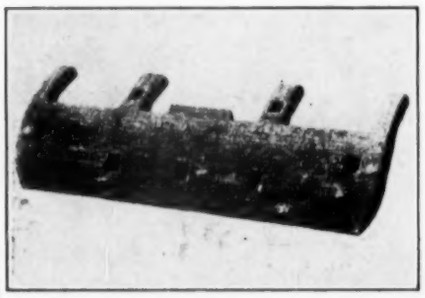


Fig. 13. Hard-Faced Draghead Shoe of Hopper Dredge.

Fig. 14. When Hard-Facing Is Properly Applied, the Cutting Edge Remains Sharp in Service.

to which its equipment is subjected, it will be evident that only a few of the outstanding applications of hard-facing in this field have been touched upon in the foregoing. No other industry is in a better position to profit from the longer life and increased efficiency of hard-faced equipment than the dredging industry. It is pleasing to note that dredging companies everywhere are becoming acutely conscious of this fact. Many of them have already standardized on hard-facing, for both new and worn equipment. Their experience furnishes the best proof of the remarkable savings and other benefits which can be derived from its use.

Makes Modern Road Drag From Old Type of Grader

An obsolete type of Wehrle road grader was recently converted into a road drag by using welding, the work being done by the John J. Hill Co., machine and job welding shop, of Rochester, Ind. Only the old superstructure was utilized, and I-beams and angles were used to form a new bottom structure. Old and used drag blades were employed, and the entire assembly was fabricated by oxy-acetylene cutting and arc and gas welding.

The highway department states that this converted grader is superior to a new one recently purchased, and besides it can be operated with only one man whereas the new one requires two men.

Arc Welding Used in Widening Bridge

Arc welding played an important part in reducing the weight of the recently remodeled and widened University bascule bridge at Seattle, Wash. The bridge,

Fig. 1. View of Welded Brackets and Stringers for Outer Roadway. Original Sidewalk Brackets in the Background.

built some 17 years ago, originally had a 40-ft. roadway for double-track street-car service. Vehicular traffic had increased from 8,000 per day in 1919 to 38,000 per day in 1931 when it was decided to widen the bridge.

Widening was accomplished by building roadways outside the bascule trusses, as shown in Fig. 1. These traffic lanes are supported on arc-welded brackets securely tied to the floor beams through slots cut in the vertical truss members. The brackets have tapered bottom flanges (see Fig. 2), and vertical stiffeners are welded to the web. The stringers

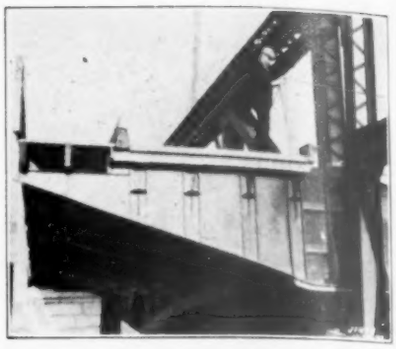


Fig. 2. Bascule Leaf Raised to Show Outer Roadway Brackets.

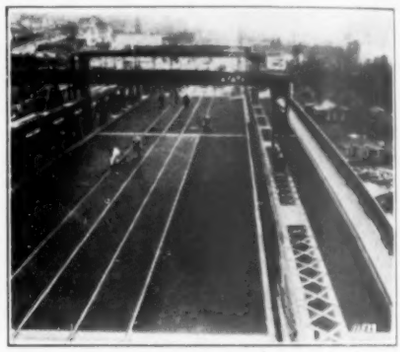


Fig. 3. View of Bridge After Widening.

extend through slots in the bracket webs and have plates welded to the upper and lower flanges.

Arc welding was used for all shop fabrication. Hand rails for the bridge were also arc welded.

Welding was done by the Puget Sound Bridge & Dredge Co., contractors for widening of the span, using welding equipment manufactured by The Lincoln Electric Company, Cleveland, Ohio.

Reclaims Tractor Worm Gears by Welding

A problem of wear that is rather common has been solved in an interesting manner by Wm. J. Volpert, proprietor of the Volpert Welding Shop at Peru, Ind. The article in question is a Fordson tractor worm gear. The spleen wears very badly and then usually is thrown away. Mr. Volpert builds these parts up with Oxweld No. 25 bronze and then machines them.

A new gear costs $15 to $18. This repair can be made to sell to the owner for $5, including machining, which leaves a nice profit to the welding shop. About 35 of these gears have been reclaimed by this method, and all are giving satisfactory service.

Huge Welded Pipelines With Steep Grades

Conquering canyons and straddling mountains, a 4½-mile arc-welded pipe line will soon join Bouquet Canyon Reservoir with the Owens Valley Aqueduct, near Saugus, Calif. The line will form a part of the gigantic system of the Department of Water and Power, City of Los Angeles. A view of a section of the new line is shown on the front cover of this issue.

The new Bouquet Canyon dam replaces the Saint Francis dam which was

Each Joint Requires 450 Lb. of Welding Electrode.

destroyed several years ago. Water will be carried from the reservoir back of the dam to a power house surge chamber where the Owens Aqueduct also empties.

The pipeline under construction is said to be the largest in the West. It varies in diameter from 7 ft. 10 in. to 6 ft. 8 in., depending upon the pressure. The 80-in. pipe, with a wall thickness of 1-1/16 in., is used where the pressure is the greatest. At the bottom of one of the canyons crossed, the internal pressure is equal to 400 lb. per sq. in. The country traversed by the line is extremely rough and the pipe has some very steep grades.

Fabrication of the pipe is handled by the Western Pipe & Steel Co. Laying of the line, and field welding, are done by the Los Angeles Department of Water and Power, using Fleetweld electrodes manufactured by The Lincoln Electric Co., Cleveland, Ohio. For both the pipe fabrication and the field welding, the shielded-arc process of welding was adopted.

Sections of pipe, each weighing approximately 12 tons, are hauled by trucks to the job, where the Los Angeles Department of Water and Power have a sand-blasting and painting plant which cleans and paints the pipe before being placed. When painted, the pipe sections are hauled on trucks to the top of the mountains and then lowered by a hoist down the canyon sides with carriers called "straddle bugs" designed for handling this pipe.

An idea of the size of this pipe is gained when one learns that it takes 450 lb. of electrode to weld each joint on the job. Thirty-two man-hours is required to weld the outside of each joint and 24 man-hours to weld the inside. The welding is being carried on 24 hours a day in three 8-hour shifts.

Welds Water Main 40 Ft. Under River

The repair-welding of a large crack in a 72-in. water main 40 ft. under the Hackensack river in New Jersey saved the expense of building a new main at an estimated cost of $125,000. The story of this perilous undertaking, as told by Harry Schriefer, of the Standard Welding & Spring Co., of Jersey City, N. J., who had charge of the work, is a tale of such fortitude and courage as men are seldom called upon to show.

Tests showed that 5,000,000 gallons of water a day was being lost in this main, and sounding rods showed that the leak was at Sauer Island, 400 ft. off shore, 40 ft. below the surface of the river. The leak was thought to have been caused by settling of the main.

At Schriefer's recommendation, the water pressure in the damaged line was cut off and diverted into a parallel 72-in. main. The next step was the cutting of a large manhole in the pipe on Sauer Island, and through this the water was pumped out of the pipe to a level of 24 in. at the break—the lowest point in the pipe. With the removal of the water, the pipe became lightened and began to float, so it was necessary to carry thousands of bags of sand into the pipe to weight it down, as the floating of the pipe was likely to cause an unduly strained condition and further breakage. It required several days for men to carry the sand bags through the manhole and down to the bottom of the river.

During this time, the break, which extended seven-eighths of the way around the pipe, and at its widest point spread one inch wide, was caulked with wooden pegs to keep the water from flowing in faster than the pumps could carry it out. After two and a half weeks' work, the pipe was weighted down sufficiently to permit the welders to start their work.

First, bags of cement were piled around the pipe on the outside to help keep out the river water, and the wooden pegs forced into the crack were strengthened. Then a large steel sleeve was made in two sections, and this was carried into the pipe and jacked into place. Unfortunately, the break in the pipe occurred next to a row of rivets whose heads projected almost a full inch from the inside surface of the pipe. The crevice between the pipe and the sleeve, caused by the projecting rivet heads, therefore had to be packed with lead.

The welding was then started. Standing knee deep in water, the operators welded the sleeve to the pipe. The heat of the arcs vaporized the constantly dripping water and fused the metal at the same time. Steam and gas fumes filled the pipe, despite the air pumps which worked continuously night and day while the welding was progressing. Under such severe conditions, men could not stand up long. No welder worked more than two hours at a stretch except for completing some necessary piece of work.

The upper part of the sleeve was welded into place first, and the dripping water was carried away to the bottom of the pipe by means of drains which were put into place prior to the start of the welding operations. When the work approached the bottom of the pipe, an air hose was let in between the sleeve and the pipe to force as much of the water as possible out of the crack into the river.

Further strength was given to the construction by welding heavy steel angles, bent in perfect circles, to the joint on each side of the sleeve.

The pipe line has now been in service for several months and is performing satisfactorily.

Manhole Which Welders Entered to Repair Break at Bottom of River.

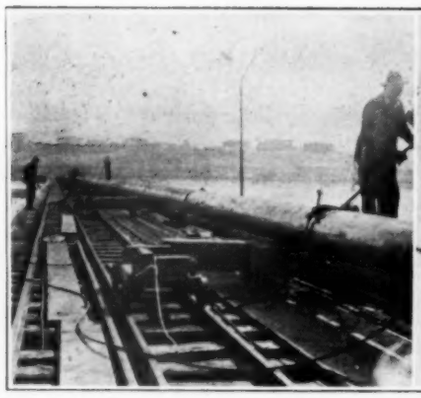


Fig. 1. Looking Toward Shore, Showing 16-in. Line Ready to Be Rolled Over Onto Launching Cars.

Fig. 2. Cutting Bull Plug from End of First String of 16-In. Line.

Fig. 3. Tack Welding 16-In. Line for Final Tie-In.

Welding and Laying an Under-Sea Pipeline

■ By W. E. ARCHER

WELDING recently contributed to the successful laying of an interesting and unusual pipe line near El Segundo, Calif. This pipeline is termed a submarine line, being laid on the floor of the ocean and extending from the end of a pier for over a mile out into the ocean. The line was laid by the Standard Oil Co. of California and is used for loading and unloading gasoline, crude oil, fuel oil, etc. With these facilities for loading, a great saving in port charges such as dockage, wharf and pilotage charges is effected, in that the oil company's ships can be anchored and loaded at the end of the submerged line in the open sea. The recent handling of two cargoes alone through this line saved the company something over $1,300.

Loading of the oil is done entirely by gravity, as the storage tanks on the shore have a considerable elevation above the point of loading. It is estimated that the flow through the line into the ships under normal conditions is at the rate of 6,000 barrels per hour. A 175-ft., 12-in. heavily reinforced rubber loading hose connects the outer end of the line with the ship to be loaded. When not in use, this hose lies on the bottom of the ocean with the end marked by a light-buoy to which a chain is attached. At this point the water is 50 ft. deep. In addition to the ship's anchor, there are five large buoys marking extra anchors used for safety in loading in heavy weather. To each of these buoys is attached a heavy anchor chain leading to 16,000-lb. anchors. This mooring is said to be sufficient to allow ships to load in any kind of weather.

Two Pipelines of Different Diameters

The installation of this pipeline involved the use of two sizes of pipe. The main loading line is of 16-in. pipe, and this is paralleled by a circulating line of 8-in. pipe. All of the pipe was welded by the oxyacetylene process, employing ¼-in. high test (Oxweld No. 1) welding rod on all of the 16-in. pipe, and Oxweld special pipeline welding rod No. 24 (⅜-in. size) for roll welding all of the 8-in. circulating line.

Rolling welds were employed in welding the joints of both sizes of pipe into sections, or "strings," 240 ft. in length, but in tying these sections together rolling welds were not deemed practicable owing to the length of the sections and lack of adequate facilities on the pier. Position welds, better known in pipeline welding as "bell-hole" welds, were made in these instances. All tie-in welds were made with the ¼-in. high-test rod, regardless of the diameter of the pipe.

The laying, or launching, of the lines was done by welding the 240-ft. sections into long strings, and pulling these strings out into the ocean from the end of the company's pier, after being welded together at the end of the pier. The pier was equipped with a small railroad track

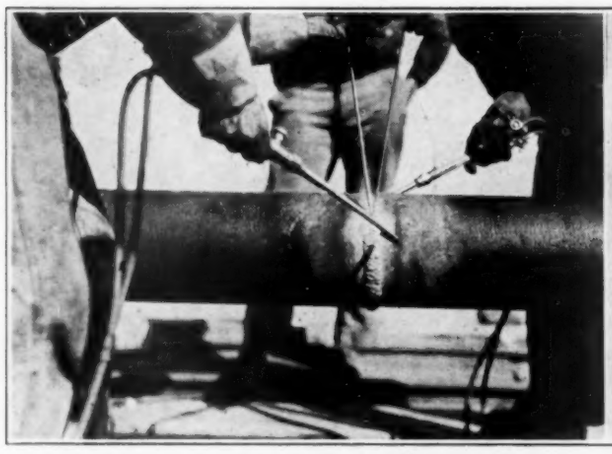


Fig. 4. Tieing-In Two 8-In. Strings.

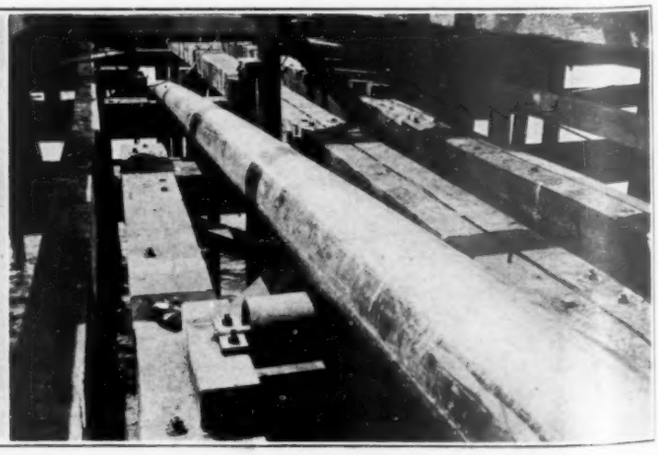


Fig. 5. The Line Is Guided Against Horizontal and Vertical Rollers as It Enters the Ocean.

on which were placed small dolly cars for carrying the welded pipeline preparatory to launching. This afforded a simple and easy means of pulling the long strings, using a large towing engine on a large company steamer anchored on a correct line some 500 ft. beyond the proposed outer end of the submarine line. A heavy steel cable was brought from the steamer and attached to the end of the line. Slowly the line was drawn into the ocean as the sections were one after another welded together.

A general view of the line looking shoreward from the outer end of the pier and showing a string of the 16-in. line welded and ready to be rolled over onto the launching dolly cars, is shown in Fig. 1. Fig. 2 shows a welder cutting off the bull plug from the end of the first string of the 16-in. line. This bull plug was welded on with a heavy link and hook attached for holding the end of the string steady in launching. Note the heavy welding on the plug.

Figs. 3 and 4 are close-up views of the tack welding preparatory to tying together the final string of the 16-in. line, and two welders tying in two sections of the 8-in. circulating line with a heavy weld.

Rollers at End of Wharf Act as Guides to Pipe

As the 16-in. line leaves the wharf on its downward course into the ocean, it is carried on rollers placed at intervals to assure the proper angle and to prevent undue strain on the line. These are shown in Fig. 5.

The welding together of all of the sections of the line and the entire completion of the launching of both the 16-in. and the 8-in. lines was done in approximately 11½ hours.

Both the 8-in. and the 16-in. pipe was prepared for welding by beveling to an angle of 35°. After welding and before launching, the line was subjected to a hydrostatic pressure test of 500 lb. per sq. in. No leaks of any kind were detected in any of the welds.

Big Saving in Building Up Worn Treads

A job of building-up hinges and driving lugs on the treads of a Koehring shovel was recently completed by W. C. Paddock of the Peoples Welding & Machine Co., Lafayette, Ind., at a cost of approximately $300, compared with a cost of over $1000 for new treads. The time required was four days and two nights continuous work.

There were 56 treads in all, and these had become badly worn due to hinge action. Arc welding, using Ryerson green-coated rod, was used to build up these hinges and the driving lug on the inside of each tread. A reinforcement was also used to give additional wear.

Get "*H. O. T.*" on Welding

■ Edited by
H. O. T. RIDLON
Welding Consultant, Joliet, Ill.

[This section is dedicated to Better Welding and Better Welding Shops. Suggestions and criticisms are invited.]

A Sermon Addressed to the Job Welder

The caption of this might be the same old sermon all ye church-goers have so often heard, "Seek and ye shall find!" or the other one, perhaps less well known, "To him that hath shall be given, and he that hath not, even that which he hath shall be taken away!" I shall try to modernize those two great lessons for you, my friends, the welding contractor and the welding operator. Note that I say nothing about the job-shop owner, for that old bird is now passing out of the picture with exceeding rapidity, for truly he is either the welding contractor or else—"even that which he hath shall be taken." And here's what I mean by that:

Having an arc machine of more or less antiquity, and an oxyacetylene outfit, doesn't make a job shop a welding contractor—not by a jugful. To be a welding contractor, you must keep up-to-date on all the new things of the industry. Being a good operator doesn't make you a contractor, or because you pull a fast one and get a big job by cutting all the corners known to the industry to land it and by doing a lousy job you have the exceedingly good fortune of making a few paltry dimes.

The welding contractor should be an honest, legitimate merchant. Yes sir, you're selling something of great value to your community—and to your boss, if you are a welding operator. You must read and study with exceeding diligence. Attend the welding clinics, the metal shows, and work with the technical schools in your town. If not, you're going to be left with some darn old equipment, wondering what it's all about.

Take a course in salesmanship and business management, and apply the principles you learn to your business. You've got a selling job as well as a welding job and oftentimes an engineering job.

Believe it or not, I know of cities of great population that haven't a job shop who could be trusted to do a first-class hard-facing job, and yet these shops call themselves welders. In my own town, within the past month, a shop owner was forced to do some hard-facing and wanted me to tell him all about it in five minutes—and he's been in business 22 years!

This welding game really has the biggest future of anything a man can get into to-day, and yet there is less known about it than any other. Many shops I know of are busy as bee hives and making a good profit on every job. Perhaps you're one of the others, with old equipment, who can only buy C. O. D. If you are, my heart goes out to you. If you're going ahead, working, studying, learning, enjoying a growing business with a profit in every job, I want to sing your praise. This goes for the welding operator, too.

Changing the parables to fit you: Sell, and you'll get the order or the job. You who have knowledge will beget more and profit thereby. If you insist on being a "knot-head" all your life, take it on the chin and at least be a man, honest enough not to spoil another fellow's chance who is trying to help himself and the industry in which you're just a leach.

• • •

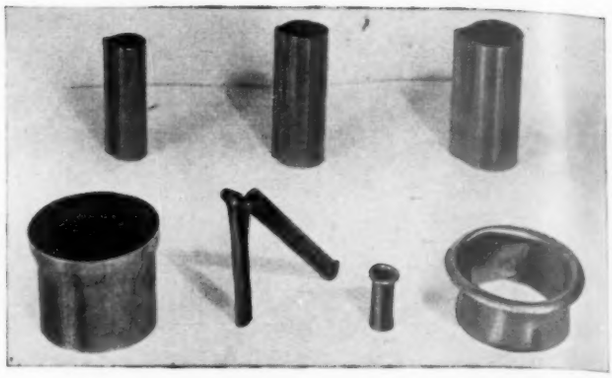
A Few Tips On Cast Iron Welding With the Torch

So help me, much has been written about the welding of cast iron—and the well-known hard spots and unmachinable welds. No doubt all this theory is absolutely correct, and I heartily agree that a welding rod of the proper analysis is extremely important, and so forth and so on. I'm referring to welding cost iron by the oxyacetylene process. We won't fight with you are hounds. So you smart boys, who can still handle a torch, after you know you have a good cast-iron welding rod, and know everything else is just as it should be, I want to draw you a picture which I believe will really help you with any cast-iron welding troubles you may be having, which are quite a few, judged by all the letters that have come to me from all over this wide and broad land of ours.

When it is necessary to line up a job on a flat plate—OK, go ahead. But when you do your welding, put firebrick under your job. And that's all there is to it. Simple, eh? Just why does that help it? Because a large, heavy metal section under your cast-iron jobs will draw the heat away from your work and cause what I choose to call "cold shots"—there's a more technical name for it, but I'll just skip that—while firebrick will radiate the heat back into the piece being welded instead of drawing it out and causing sudden chilling next to or in the weld. And so-ooo, you'll find you've licked that trouble if you are following the other accepted practices in welding cast iron.

P. S. Another hint: Use a good flux—but somewhat sparingly.

Fig. 1. Inconel Gas-Welded Tubing Shows High Ductility



The Welding of Inconel . . . .

Paper presented at Fall Meeting of American Welding Society, Detroit, Mich., Oct. 2-5, 1933.

■ By F. G. FLOCKE, J. G. SCHOENER, and R. J. McKAY
International Nickel Company, Inc.

THE development of the new alloy, Inconel, has been contemporary with progress in the welding industry. At the same time that the properties of this alloy were being studied, advances in the speed and facility of welding and in the strength and soundness of welds were being announced. It was thus natural, as well as necessary, that welding facility should be one of the principal criteria determining whether this composition deserved launching into competition with the many other good corrosion-resisting alloys.

Some research was necessary to develop proper fluxes for electric welding and to determine the proper procedures for oxyacetylene welding. It was found in this research that the welding characteristics of the metal were satisfactory, that suitable rods and welding methods could be used and welds made with ease combining physical and corrosion-resisting properties which compared favorably with those of the parent metal. To obtain this welding facility it was not found necessary to change the composition of either parent metal or welding rod from that desired for the best physical and corrosion-resisting properties. Heat treatment was not found necessary and the heat effects of welding not deleterious.

Composition and Characteristics of Inconel

Inconel is fundamentally nickel to which sufficient chromium has been added to make it non-tarnishing in any form or finish, and since ferro-chromium is used in making this addition, some iron is present. The analysis is 80% nickel, 14% chromium, 6% iron.

This alloy, originally introduced and intended for use in the dairy industry, has been used in the construction of holding and storage tanks, vats, coolers and regenerators. Its adaptation in that field indicated a certain usefulness in the food and canning industries, in which fields it has been used as steam-jacketed kettles and cookers. A relatively high interior finish, as well as a corrosion-resistant surface, is required here as in the dairy field. The high strength and ductility with high impact value, high modulus of elasticity and strength and resistance to oxidation at high temperatures, have led to introductory uses in such widely separated fields as nitriding

Fig. 2. Curves of Tensile Properties of Annealed Inconel at Elevated Temperatures.

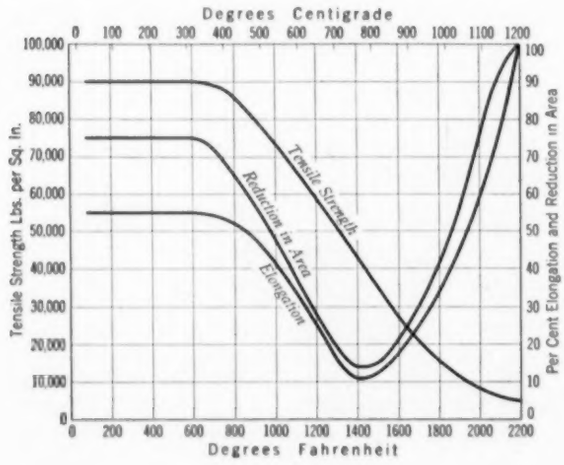
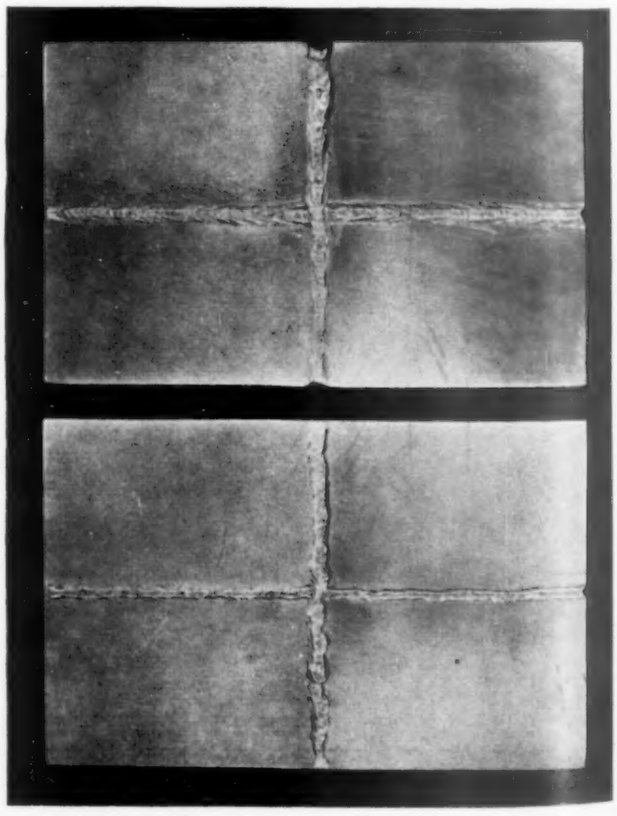


Fig. 3. Metallic-Arc Weld on ⅛-In. Inconel Sheet, Welded From One Side.

(The complete and uniform penetration is to be seen in the lower view.)



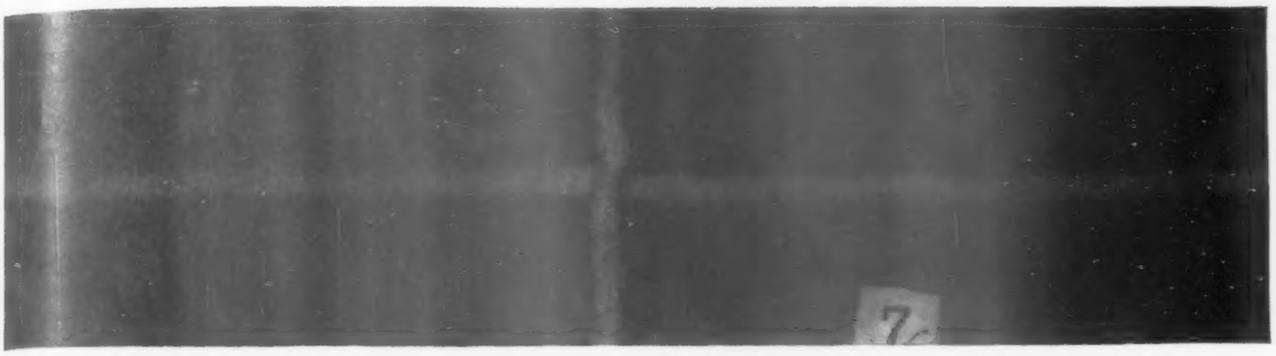


Fig. 4. X-Ray Image of Weld Shown in Fig. 3, Indicating Complete Absence of Porosity, Cracking, or Lack of Fusion.

boxes, tube or sheet coverings for domestic-range heating elements, airplane exhaust manifolds, screen wire, textile machinery, and brewing and distilling equipment.

For all these uses, Inconel is available in the usual commercial forms as sheet, plate, strip, rod, tube and pipe, both seamless and welded, forgings and special shapes.

To make satisfactory joints in a variety of shapes and gages and under practical shop conditions welds must meet a number of different requirements. The present discussion has been shaped to take up these several requirements in order, as follows: (1) weldability; (2) strength; (3) ductility; (4) soundness; (5) weldable thickness range; (6) finishing welds; (7) ease of repair; and (8) corrosion resistance of welds.

Procedure for Welding

Inconel can be joined by all the commonly used methods of welding, including fusion and resistance methods.

The development of a flux-coated electrode for metallic-arc welding has contributed to the ease with which the metal can be welded. The action of this flux was described briefly in a paper presented before the American Welding Society at their annual meeting in Buffalo, October, 1932, entitled "The welding of High-Nickel Alloys." Since that time improvements have been made in the working characteristics, as well as in the manufacture of the rod.

The relatively thick coating employed permits maintenance of a uniformly short arc, reversed polarity being used. Since the molten metal is extremely fluid, good penetration is practical. This point is of particular interest in the welding of sheets less than 3/16 in. thick, where, in the case of butt joints, sufficient penetration must be obtained to permit grinding and polishing of the penetrated weld on the underside, while enough reinforcement must remain on the top side of the weld to provide strength and adequate stiffness. An example of the uniform and excellent penetration of Inconel welds is seen in Figs. 3 and 5(a).

Gas welding affords another method of conveniently joining Inconel. Since little difficulty is encountered in the gas or electric welding of pure nickel, no trouble was anticipated with this new metal, which has the characteristics of pure nickel only modified by the chromium addition. While no flux is ordinarily used in gas-welding pure nickel, it was found that unless considerable care was exercised in gas-welding Inconel, the chromium constituent would oxidize very readily when flux was omitted. For foolproof welding, a flux marketed by a prominent manufacturer of welding apparatus and accessory material, and generally recommended for the gas welding of chromium-bearing alloy, was found to be a convenient means of keeping the oxidation under control. This flux, in the form of a thin paste painted on the welding rod as well as on both sides of the sheets being welded, and used in conjunction with a very slightly reducing flame, makes for sound, ductile welds of good strength.

Automatic gas welding is the method employed in the manufacture of small-diameter tubing used for domestic electric ranges and in the dairy industry. Here, with temperature and atmosphere

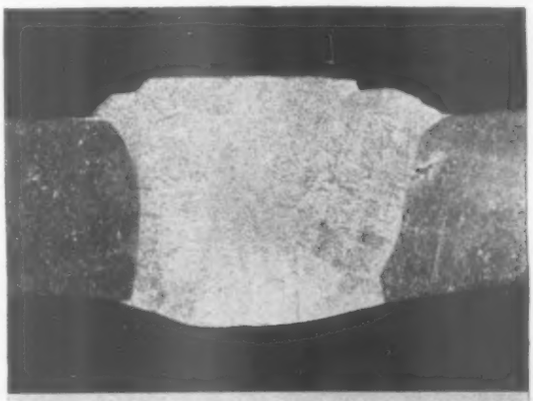


Fig. 5a (Right). Micrograph of Weld Shown in Fig. 3, at 10 Diameters.

(In the micrograph below, the weld (darker half) is a typical structure of cast metal, while the left half shows a typical sheet-metal grain orientation. This welded joint has a tensile strength of over 90,000 lb. per sq. in.)

Fig. 5b (Below). Composite Micrograph of Inconel Weld and Sheet, at 100 Diameters.

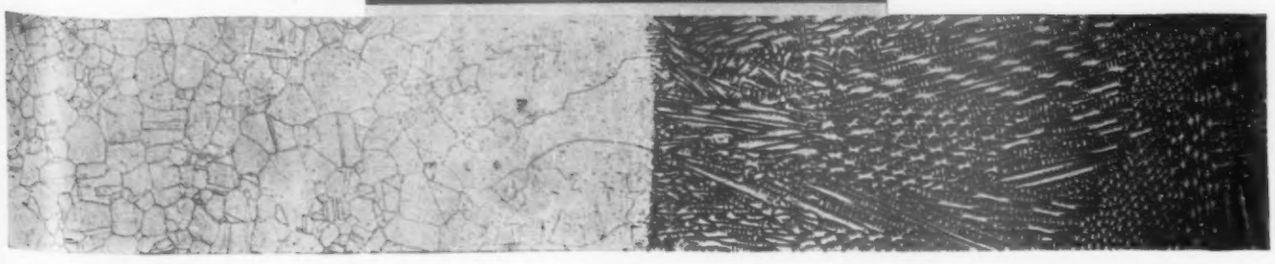


Fig. 6a (Right). Photomicrograph of Inconel Oxyacetylene Weld, at 14 Diameters.

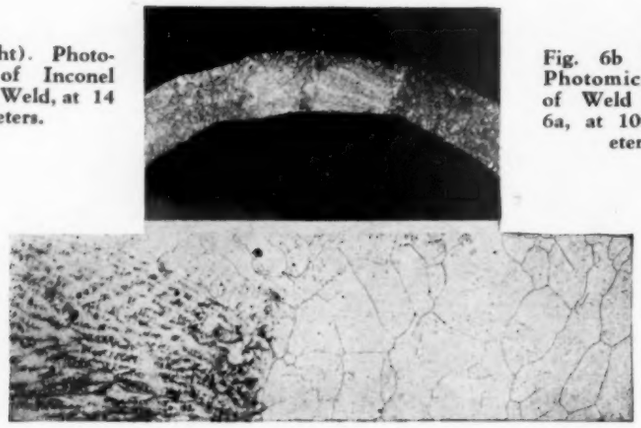


Fig. 6b (Below). Photomicrograph of Weld in Fig. 6a, at 100 Diameters.

under accurate control, no flux is found necessary. A completely formed gas-welded Inconel heating unit shown in Fig. 7 is an example of quality welding.

Strength and Ductility

In the case of an engineering material such as Inconel, considerable interest usually centers about the tensile strengths of both the sheet and weld metals. Knowledge that the strength of the welded joint is sufficient is of particular importance so that butt joints can be used in design without hesitation and without fear of failure.

The physical properties of Inconel sheet in the annealed state are listed in Table I along with pure nickel, Monel metal and mild steel, for making a quick comparison.

The results of a series of tensile tests on butt-welded joints of both 1/16-in. and 1/8-in. thick sheet, gages which are fairly representative, are tabulated in Table II, and show that electric-arc welds were developing strengths of over 90,000 lb. per sq. in. and at the same time were 100% efficient. These welded joints were not subjected to any heat-treatment subsequent to the welding operation. Heat-treatment and corrosion-resistance are covered later, but it might be noted here that heat-treatment has not been found necessary either to restore adequate corrosion-resistance in and near the weld or to improve strength and ductility.

The ductility of sheet metal and of weld metal is important to the fabricator, as the metal must withstand all normal forming operations. The elongation of sheet given in Table I and in the curves in Fig. 2 is approximately 55% at room temperature, while that of a welded joint is about 35% in 2 in. Elongation data as determined on welded joints, while informative in connection with the complete joint, are questionable if applied independently to either weld or sheet. Their interpretation depends on the position of the fracture.

More convincing evidence of ductility so far as the fabricator is concerned is the ability to deform a weld, as, for example, to turn a flange on a welded cylinder without any sign of failure. Deformed gas-welded tubing, showing no failure in either weld or tube after expansion of over 32%, is illustrated in Fig. 1.

A usual quick test of ductility is the bending of a weld, either parallel or transverse to the direction of welding. Inconel welds withstand this drastic elongation without any visible signs of failure, even when the welded plates are hammered back to back over their entire length.

The small-diameter Inconel gas-welded tubing shown in Figs. 1 and 7 is a good example of the inherent ductility of the metal. Strip in coil is formed into straight lengths of tube, then gas-welded and swaged to size, annealed, and finally coiled to make the flat heating unit of certain domestic electric ranges.

Reference to the curves in Fig. 2 for elongation and reduction in area at elevated temperatures will disclose that these are uniform from room temperature to about 700°F. Then follows a gradual decrease in these values till at 1400°F. the ductility is quite low. This lowering of ductility is more or less characteristic of certain alloys and is referred to as the "hot-short" range.

The practical significance of these two curves is that metal should not be worked or deformed around 1400° F. temperature and that care must be taken to avoid setting up any stresses in the weld during cooling through this range if cracking is to be avoided. Where normal care is exercised in fitting up a job so that butt seams are uniformly spaced and lap joints are laid up tight before beginning to weld, little trouble is encountered. This point may become an issue if attempts are made to fill up unusually large holes resulting from improper setting up or burning through when welding, and where a large mass or quantity of weld metal must cool down together. However, even conditions such as these are easily met by following the proper technique.

Fig. 7. A Calrod Heating Unit for Domestic Heating Ranges, Made of Gas-Welded Inconel Tubing.

Freedom From Porosity

In dairy as well as food-handling equipment, interior surfaces coming in contact with milk products or food must be absolutely smooth and sanitary, with no sharp corners or depressions in the surface where bacteria may lodge and multiply. Sheet is seldom an offender in this respect, but welds have often in the past been a source of trouble from the standpoint of pits and porosity. Soundness of a weld is, therefore, all-important, and its lack becomes particularly evident if the weld is to be ground flush

Table I. Physical Properties of Various Materials in Sheet-Metal Form.

	Ultimate Breaking Strength lb./sq. in.	Ductility % Elongation	Ductility % Reduction of Area	Modulus of Elasticity lb./sq. in.
Inconel	80,000-95,000	45-55	65-75	31,000,000
Nickel	60,000-75,000	43-53	65-75	30,000,000
Monel Metal	65,000-80,000	35-50	65-75	26,000,000
Mild Steel	50,000-55,000	25-30	60-70	30,000,000

Note: These properties are all of sheet metal in the annealed state.

Table II. Physical Properties of Welded Joints in Inconel Sheets.

(Composite table of both 1/16-in. and 1/8-in. thick sheets.)

	No. of Tests	Breaking Strength, lb./sq. in.	% Elongation	Remarks
Unwelded Plate	4	95,010	50.0	
Metallic Arc Welds (as welded, raw)	6	93,540	35.0	Broke in plate.
Metallic Arc Welds (dressed)	12	92,750	36.9	9 fractures in plate, 3 fractures partly or wholly in weld.

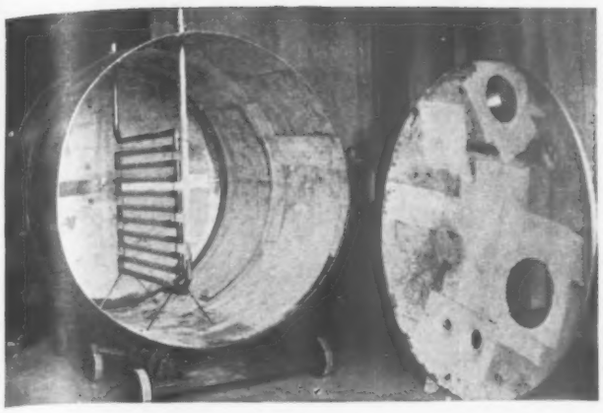


Fig. 8. All-Electric-Welded 2000-Gallon Tank for Aging Ice Cream, Made From 5/32-In. and 3/16-In. Inconel Sheets.

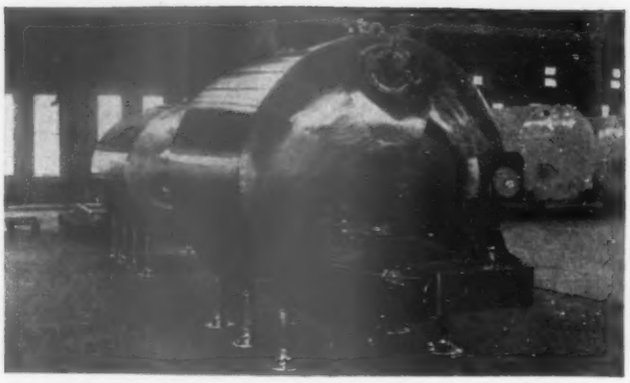


Fig. 9. Two Completed 2000-Gallon Inconel Aging Tanks. The Inconel Sheathing Takes a High Finish.

with the surface of the sheet and polished.

Further laboratory examinations of Inconel welds, other than the usual tensile tests, were believed useful to completely determine their soundness, and with this thought in mind the following means were applied: (a) X-ray examination, (b) a type of nick-break test, and (c) macro- and microscopic examination of typical Inconel welds.

The exograph of the Inconel weld pictured in Fig. 3 (front and back views) is shown in Fig. 4. Examination discloses a sound weld, free of porosity, cracking, inclusions or lack of fusion.

Specimens for the nick-break test were prepared by sawing, with a power saw, through a portion of the depth of a weld 6 in. long made in 1/8-in. sheet. The fractures of these breaks showed a fine, uniform grain with no porosity.

So as to show up any possible imperfections immediately below the surface, as well as any through the center of the weld, in both the X-ray and nick-break tests, these butt welds, made with the metallic arc on 1/8-in.-thick Inconel sheet, were left "as welded."

Both the macrograph at 10 magnifications and the micrograph at 100 magnifications, in Fig. 5, are from a section of the electric weld shown in Fig. 3, and are evidence of the soundness of the joint and the weld. So that a thorough comparison might be made between the weld metal and the sheet, the single photomicrograph was prepared showing both these portions.

The weld metal is the darker zone, which is characterized by the dendritic structure of solidified molten metal. This zone is really divided into two subzones: one at the extreme right being the general weld structure, while at the left half of the darker portion is the zone in which solidification took place more rapidly. There is an enlargement of the grain between the sheet and weld —really a zone of recrystallization. This zone is one which might be produced by heating a sheet to 2200°-2300°F. and then quenching—a condition paralleling that met with in electric welding.

For purposes of comparison, a photomacrograph and a photomicrograph of an Inconel oxyacetylene weld are shown in Fig. 6.

Welding of Thin Sheets

The upper limit of plate and other sections met with in ordinary Inconel welding practice is not high because the high cost of the alloy always encourages the designer to use as light sections as possible. The sections used are usually inside the range of easy welding practice, and problems of weldable thickness need be considered only in connection with light sections.

Under ordinary conditions, it has been found that 18 gage (0.050 in.) is about the lower limit which can be conveniently welded with the metallic arc without undue buckling of the sheet. Lighter sheets than 18 gage are usually used as covers over insulation, and must have one side polished. Where it is considered worthwhile to exercise greater care in clamping of the sheets, lighter gages may be metallic-arc welded, but not without some practice. No lower limit need be set for acetylene welding, as this is dependent on the ability of the welder.

If an attempt is made to arc-weld too thin a sheet, some difficulty will be encountered in buckling. To avoid this to some extent, a jig or clamp is found advantageous in keeping the sheets in line. This procedure is recommended as highly desirable in many cases, not only with light gage, but up to 5/32 in. as well. In our experience in welding service, a short time spent in proper clamping will often save hours of effort.

Finishing the Welded Sheets

Practically all the surfaces of food and dairy equipment—not only the side contacting the food, but the exterior surface as well—are polished to a satin finish. Of course, welds made in the fabrication of these units must be readily grindable, and easily polished to the high finish required. Inconel welds are rough ground with coarse rubber-bound high-speed grinding wheels, the finish then gradually brought up by using finer grits of emery glued to sewn cloth wheels. These processes are accomplished with reasonable ease.

The interior of an Inconel ice-cream-aging tank is shown in Fig. 8. The welds are ground and partly finished during course of fabrication, and as work nears completion the protective covering over the sheet surface is removed and the interior resurfaced and brought up to the high finish required. That an excellent finish is obtainable can be seen in Fig. 9, which shows two aging tanks, each of 2,000 gallons capacity.

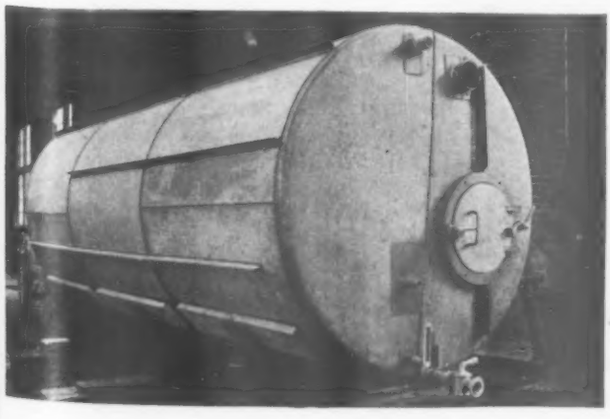


Fig. 10. Inner Shell of All-Electric-Welded 3000-Gallon Milk Storage Tank Made From 16-Gage Inconel Sheets, Before Insulation and Outer Sheathing Have Been Put On.

Frequently, despite the general excellence of welds and good welding characteristics of any metal, it is necessary to reweld an occasional imperfection. In the case of Inconel, such imperfections often take the form of a slight, incomplete penetration, which in grinding down leaves a low spot or crevice that is objectionable from the standpoint of sanitation. This is quite easily "picked up" or "spotted." The usual care in removal of the flux from the previously laid weld, and, in the case of a single small pit, using a circular movement of the electrode with a final breaking of the arc by a quenching of the arc and quick withdrawal of the electrode, will produce a sound spot. A few minutes' experience in the "spotting" of these small defects will be sufficient to develop the technique required.

Resistance Against Corrosive Agents

Inconel has complete corrosion-resistance under a great many conditions. Some thought was necessary to select a solution in which to compare the corrosion-resistance of various types of weld with that of the parent metal. If a solution were used to which the metal is completely resistant, it might well happen that the weld metal would not be attacked even though it were inferior to the parent metal. It was, therefore, thought best to select a solution which Inconel could withstand in practical use, but which would produce a visible or measurable attack. This solution was found in an acid refrigerating brine. Refrigerating brine often becomes acid in use and then will attack most metals destructively. While its effects can be measured on Inconel, the metal is not destroyed.

In a long series of laboratory tests it was found that any weld which would pass ordinary inspection for soundness would resist corrosion at least as well as Inconel sheet. Welds which have been in service for long periods in these brines and under other corrosive conditions have been inspected and found to be free from corrosion.

Strain and recrystallization in the neighborhood of welds may affect the corrosion resistance. Analysis of the test results mentioned above shows Inconel to be relatively little subject to such effects.

Inconel is not at all subject to the deleterious effects of carbide precipitation encountered in the welding of the "18-8" stainless steels and precautions to prevent weld decay are unnecessary. Laboratory studies were made subjecting welded specimens to a solution of copper sulphate and sulphuric acid—a method used extensively for testing the embrittlement susceptibility of metals. After 100 hours, the Inconel specimen had lost none of its ductility, while metal susceptible to embrittlement, exposed for the same length of time, had suffered serious intercrystalline attack. This is due to the low iron content of Inconel, the embrittling effect of carbide precipitation not being of importance except where the iron content is very much higher than is the case in this alloy.

In conclusion, it can be said that the welding of Inconel has been highly developed through extended laboratory tests in conjunction with wide field experience. Tensile and bend tests have shown Inconel welds to be strong and ductile, while X-ray and microscopic examinations have shown them to be sound. As a method of joining, welding is recommended on the basis of knowledge of what has been and can be accomplished.

All-Welded Boat Can Be Disassembled

An all-welded metal boat which can be assembled in one minute and quickly disassembled for carrying, is being manufactured and sold by the South Side Welding Co., of Indianapolis, Ind. The boat, known as the Alda portable boat, can be made in 3 or 4 sections. It has air tanks which serve as seats, making it non-sinkable. The largest single section weighs 38 lb., and a 3-section boat complete weighs 110 lb. The company built the first boat for its own use, and it was so successful that others wanted similar vessels. Now they are doing a considerable amount of business in the building of these boats.

Welded Boat Made Up of Three Sections.

Carrying a Two-Section Boat.

Large Contract for Brewery Equipment

A contract for supplying the complete brewery equipment for the Weber-Waukesha Brewing Co., of Waukesha, Wis., who are remodeling their brewery for 100,000-barrel capacity, has been awarded the Cream City Boiler Co., of Milwaukee, Wis., of which L. A. Henning is president. This equipment includes what is probably the first 18-8 stainless-steel brew kettle ever installed, this one being of 125-barrel capacity. Other equipment includes storage, aging and finishing tanks, brew house, mash tubs, hot-water tanks, etc.

William Penn Brown Passes Away

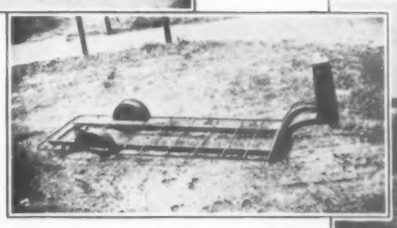
William Penn Brown, affectionately known as "Bill" Brown by the members of the welding fraternity in San Francisco, passed away at his home in Oakland, Calif., on October 31st, after a lingering illness of two years. He was vice-president and general manager of the Brown Bros. Welding Works, of San Francisco, acclaimed by many as the largest and most modern welding shop on the Pacific Coast.

Mr. Brown was graduated from Yankton College, Yankton, S. D., and later from the University of Minnesota, after which he became interested in oxyacetylene welding and cutting. In 1911 he, with his brother Hugh, joined the Metal-Weld Co., of San Francisco, where he operated the first electrolytic oxygen plant in that city.

Both brothers remained with the Metal-Weld Co. until 1916, when they organized the Brown Bros. Welding Works. Later they organized the National Welding & Equipment Co., manufacturing oxyacetylene welding and cutting blowpipes of their own design. The high quality of welding work turned out by Brown Bros. did much to dispel the skepticism of engineers and others who had little faith in the art of welding during the early days of the industry.

William Brown was a charter member of the San Francisco Section of the American Welding Society and one of its first chairmen. He was well known in marine circles on the Pacific Coast, his company having pioneered welding repairs on steamships visiting the port of San Francisco. He was an authority on welding problems, and his counsel was often sought on matters of procedure, design, specifications, and welding codes. In his passing, welding has lost one of its staunchest supporters.

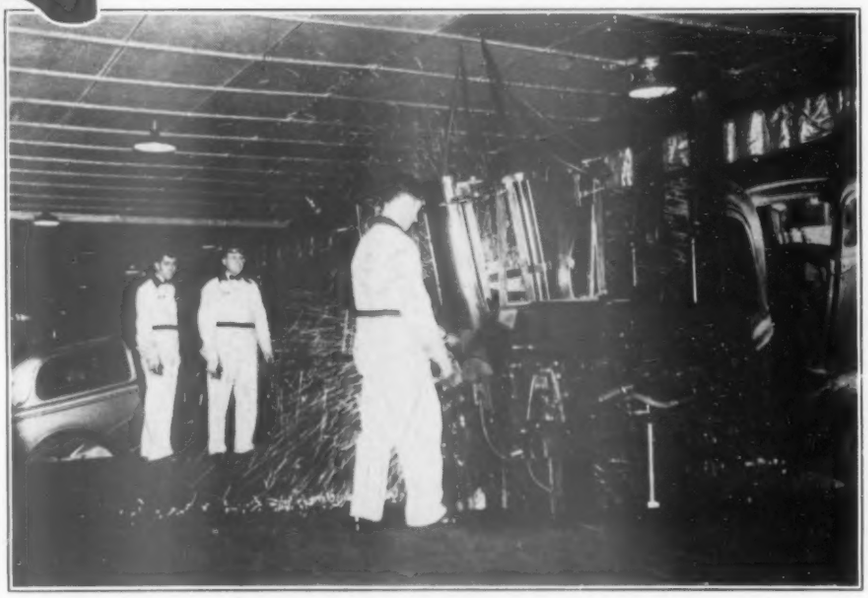
WELDING NEWS
▪ IN PICTURES ▪



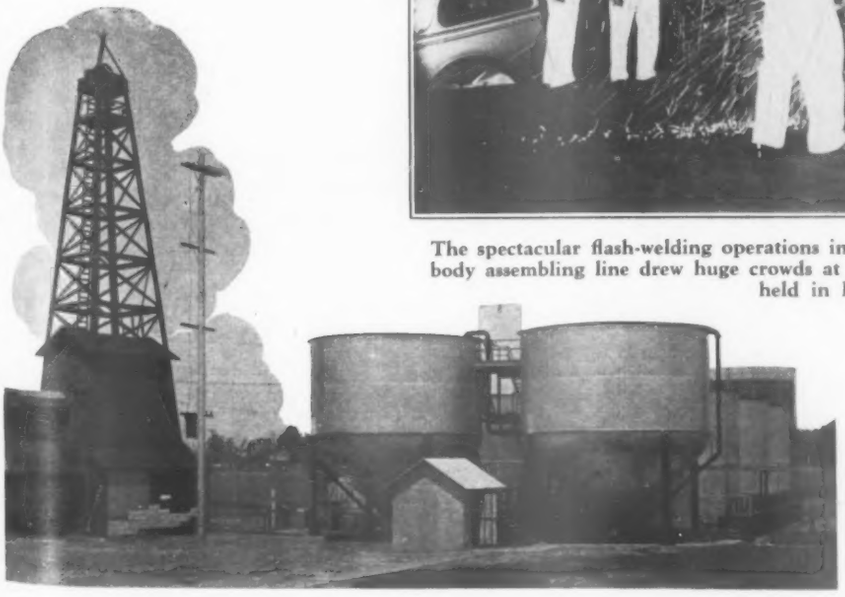
This "house on wheels" has an all-welded frame (shown at right). Made by Bochaus Welding Co., Newton, Kan.

Two-car stainless-steel "shot-welded" rubber-tired train built by the Budd Manufacturing Co., Philadelphia, for the Texas & Pacific Railroad. It will provide 50% more speed than the train it is replacing, with 1/6th of the weight, and 1/5th of the horsepower, at ½ of the operating cost.

"Steel Weld" furnaces make clean heat because every joint is welded, says the Jacob Brenner Co., Fond du Lac, Wis., who manufactured this furnace.



The spectacular flash-welding operations in the Briggs Manufacturing Co.'s all-steel-body assembling line drew huge crowds at the Ford Exposition of Progress recently held in Detroit.



All-welded settling tanks at the plant of the Morton Salt Co. at Port Huron, Mich. The two tanks in the foreground hold 80,000 gallons of brine each and were made by the Chicago Bridge & Iron Works.

Steel-Tube Construction Employed in New Building

Steel tubing with welded joints was used as diagonals for parabolic truss-girders of welded construction used to support a glass roof over the banking room of the new Postal Savings Bank in Warsaw, Poland. The framework of the dome, or cupola, of this building is also constructed entirely of tubing with welded joints. All tubular joints were welded with the oxyacetylene torch.

The span of each girder is 47 ft. 2½ in., the distance between girders 11 ft. 6 in., and the total length of the glass-covered space is 72 ft. 6 in., according to a description of this building given by Stephan Bryla in the July 20, 1933, issue of *The Modern Engineer.*

In these built-up girders, both the upper and lower chords consist of T-sections. Steel tubes of 2 in. diameter were chosen for the diagonals because their section would throw a minimum shadow on the painted glass-work to be attached to the lower chords of the trusses. These tubes were slotted with the oxyacetylene flame to fit over the web of the T-sections.

Owing to the inclination of the diagonal tubes in almost every joint, one side of the slot was too short to allow of sufficient length of fillet being used. To remedy this and ensure a sound connection, the web was extended by butt-welding mild-steel plates onto it.

This slotting of the tubes enabled the tube ends to butt against the flange of the T-sections, to which they were welded, making each tube air-tight and protecting the inner surface from corrosion by water or moist air.

Several types of construction were considered for the dome, and a tube framework was selected as being the most economical, the economy in weight alone being nearly 50%. The simplicity of the preparatory work was a further advantage, as all the rafters were made of a single bent tube, formed to a template which gave them a shape curved in the center and flat at each end.

The rafters were connected to each other by means of ring segments bent to this radius. These segments are not placed in a horizontal plane but in each case they are placed in the plane of the "great circle," which is horizontal at the "equator," or bottom of the dome, but "tilts" as it approaches the "pole," or top of the dome.

This construction allowed the curving of every tube to the same radius, whereas if complete rings had been used instead of segments and these had been placed horizontally (similar to the lines of latitude on the earth's surface), each ring would have had a different curvature. One curvature for all segments allowed them to be fabricated on the building premises, thus facilitating the work.

It would seem that other advantages of this construction are the shortening of each segment as compared with the length of the segment between rafters if whole circles were used, and the fact that making each segment a part of the arc of a "great circle" results in the segment butting each rafter at right angles so the preparation of the joints for all segments is the same.

Welded Heat Bridge Adds Life to Boiler Parts

"The use of welding in the assembly of boilers and boiler equipment is increasing. Hangers and supports for superheaters, soot blowers, water walls, brickwork, etc., if exposed to otherwise destructive heat in the operation of the boiler, will last indefinitely without deterioration, if welded to a water-cooled pressure part, such as the tubes or drums of the boiler," stated C. S. Turner, of The Detroit Edison Co. in a paper read before the Highway Congress at Detroit, Mich., held the early part of this year.

"The principle involved in these welded installations is the elimination of the air gap which always exists between two parts clamped or bolted together, and which greatly increases the resistance to heat flow between them. The weld functions not only as a fastening, but as a metallic heat bridge.

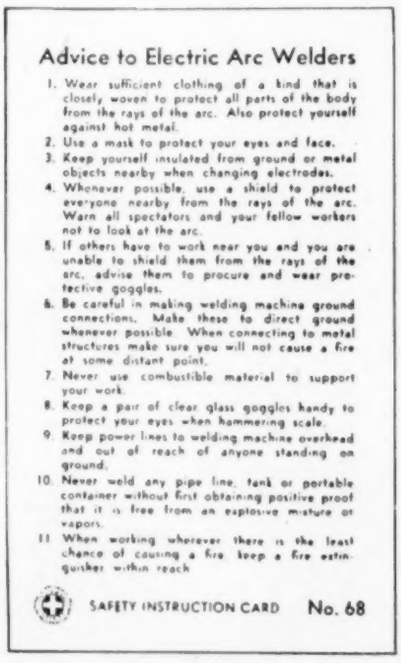
"Several important uses for the welded heat bridge are being developed in auxiliary boiler equipment, as, for instance, equipment for soot removal, in which the high maintenance cost commonly encountered with clamped or bolted equipment is greatly reduced by welding the soot-blowing elements to each of a selected number of boiler tubes. These elements are welded in such a way that they are cooled to safe temperatures, even in parts of the boiler formerly too hot to equip at all."

A. W. S. Inaugurates Drive for Members

A member-for-member drive which will continue until Jan. 1st is in progress by the American Welding Society, according to an announcement sent out from the national headquarters, at 33 West 39th St., New York, N. Y., to all members. New members joining the Society are offered free any one of the many bulletins that have been issued by the Society in the past. To help make it worth while for members to take an active part in this drive, it is stated that any member will have his membership dues credited with 10% of the total amount obtained as dues from new members obtained by him. This offer applies only where the member obtains two or more new members, operating and student members excepted. The drive is being actively promoted by A. E. Gaynor, chairman of the Membership Committee.

Safety Instruction Cards Pertaining to Welding

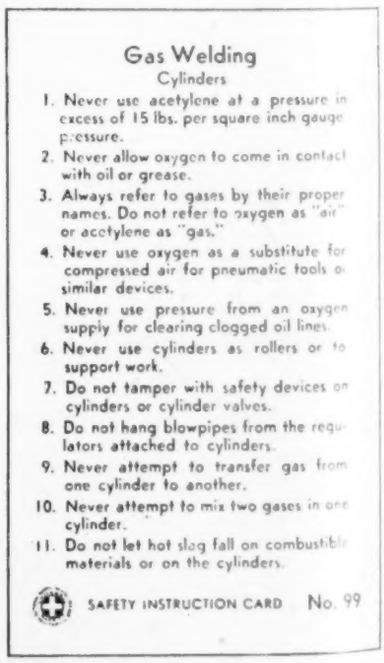
Two "Safety Instruction Cards," Nos. 68 and 99, are reproduced herewith. These are printed on white card stock, 3x5 in., slightly heavier than government postal cards. These cards can be obtained from the National Safety Council, 20 N. Wacker Drive, Chicago, Ill., at one cent each, with a minimum order of 25 cents. The size is such as to fit most pay envelopes; and when tacked on the wall over a work bench or a machine, they will not tear off easily.



Advice to Electric Arc Welders

1. Wear sufficient clothing of a kind that is closely woven to protect all parts of the body from the rays of the arc. Also protect yourself against hot metal.
2. Use a mask to protect your eyes and face.
3. Keep yourself insulated from ground or metal objects nearby when changing electrodes.
4. Whenever possible, use a shield to protect everyone nearby from the rays of the arc. Warn all spectators and your fellow workers not to look at the arc.
5. If others have to work near you and you are unable to shield them from the rays of the arc, advise them to procure and wear protective goggles.
6. Be careful in making welding machine ground connections. Make these to direct ground whenever possible. When connecting to metal structures make sure you will not cause a fire at some distant point.
7. Never use combustible material to support your work.
8. Keep a pair of clear glass goggles handy to protect your eyes when hammering scale.
9. Keep power lines to welding machine overhead and out of reach of anyone standing on ground.
10. Never weld any pipe line, tank or portable container without first obtaining positive proof that it is free from an explosive mixture or vapors.
11. When working wherever there is the least chance of causing a fire, keep a fire extinguisher within reach.

SAFETY INSTRUCTION CARD No. 68



Gas Welding

Cylinders

1. Never use acetylene at a pressure in excess of 15 lbs. per square inch gauge pressure.
2. Never allow oxygen to come in contact with oil or grease.
3. Always refer to gases by their proper names. Do not refer to oxygen as "air" or acetylene as "gas."
4. Never use oxygen as a substitute for compressed air for pneumatic tools or similar devices.
5. Never use pressure from an oxygen supply for clearing clogged oil lines.
6. Never use cylinders as rollers or to support work.
7. Do not tamper with safety devices on cylinders or cylinder valves.
8. Do not hang blowpipes from the regulators attached to cylinders.
9. Never attempt to transfer gas from one cylinder to another.
10. Never attempt to mix two gases in one cylinder.
11. Do not let hot slag fall on combustible materials or on the cylinders.

SAFETY INSTRUCTION CARD No. 99

Instruction Cards Issued by National Safety Council.

Philadelphia Section to Consider Boiler Code

The A. S. M. E. boiler code as it relates to the fabrication of unfired pressure vessels, will be the subject of a paper by W. D. Halsey, assistant chief engineer, Boiler Division, Hartford Steam Boiler Inspection & Insurance Co., to be given before the meeting of the Philadelphia Section of the American Welding Society, Monday, November 20th, at 8 p. m., in the auditorium of the Engineers' Club. The Philadelphia Section will hold no meeting in December.

Low-Temperature Welding of Aluminum

By A. C. BLACKALL

An entirely new method of welding aluminum without the use of metal in metallic form has been invented by a Stockholm engineer. The invention, which has been carefully tested by official and private institutions, consists of a paste which can be used for welding at the comparatively moderate temperature of 300°C. and with the aid of an ordinary soldering lamp. One of the greatest advantages claimed for this new method is that it makes possible the continuous welding of long strips of aluminum without the previously used point-welding procedure. It is therefore claimed that it will prove to be of the greatest benefit not only to the aluminum industry but also to allied industries, such as the automotive and aircraft industries.

Makes 12-Cylinder Engine From 16-Cylinder Unit

A 12-cylinder V-type engine (6 cylinders on each side), made from a 16-cylinder V-type engine by cutting and welding, has just completed a 2-year test and is still in running condition. The work was done by the South Side Welding Co., Indianapolis, Ind., of which Al Martin is proprietor, for the Nordyke & Marmon Motor Co.

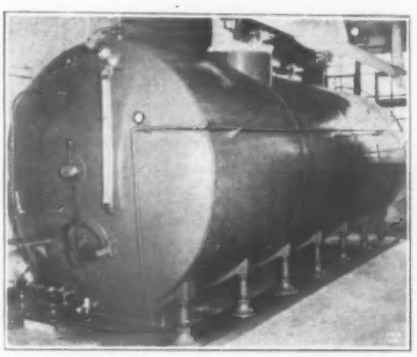
The motor company wanted this engine for experimental purposes, but it was required that it be the same size and style as the 16-cylinder engine. The middle cylinders on each side of the "V" were cut out from a 16-cylinder block, and the same amount cut out of the heads, then the two 6-cylinder blocks and heads were welded together. The job was put on an experimental car, which has been put to every shop and road test imaginable.

Before welding, the parts were lined up from the face and cylinders and bottom of the block, preheated with gas, and oxyacetylene welded, using Oxweld Lynite rod.

Welded Steel Tank for Making Champagne

The 6000-gallon carbonating and cooling tank shown in the illustration was recently fabricated by the Cream City Boiler Co., of Milwaukee, Wis., for a beverage plant for making champagne. This tank is made from ¼-in. steel plate with all seams welded, and has flanged and dished heads. It is equipped with a refrigerating unit, agitator, and telegage for accurate measuring of the contents. The working pressure is 50 lb. per sq. in.

The tank can cool 6000 gallons of liquid from 80°F. to 32°F. in 20 hours. The cooling is produced by two direct-expansion ammonia cylinders which are immersed in the liquid. The agitator and its shaft are made of 18-8 stainless steel. The tank is lined with special mammut,



All-Welded Steel Tank of 6000-Gallon Capacity Built for Brewery.

and an insulating covering helps to control the liquid temperature. The all-welded floor brackets which support the tank are easily adjusted by means of a wrench to fit the contour of the floor.

Blacksmiths' and Welders' Codes Not Competitive

The Horseshoers' and Blacksmiths' Industry Code of Fair Competition, adopted at the national convention of the Master Horse Shoers' and Blacksmiths' Protective Association held in Chicago, Sept. 26th, contains no references whatever to the welding processes except under the heading of "Definitions," where appears this paragraph: "Gas Welding and Arc Welding: Ornamental iron work, railings, forgings, etc." This omission is not due to any lack of appreciation of the importance of the welding and cutting processes on the part of the baleksmiths, says Robert Faulkner, secretary of the blacksmiths' national association, but resulted from a feeling among the members that the welders' associations are really the qualified bodies to deal with matters pertaining to the welding processes, and many of the blacksmiths are active members in local welders' organizations.

Speaker Describes Large Pipe Job

The first fall meeting of the Los Angeles section of the American Welding Society was held on October 19th at Cole's Cafeteria, in Huntington Park. The meeting was presided over by Chairman Ben M. Laulhere, engineering supervisor for the Southern California Gas Co.

Following a plate dinner at 6:30, a brief business session was held, during which P. L. Sterkle, general superintendent of the Western Pipe & Steel Co. gave a short talk outlining the work now in progress in his plant of fabricating a large steel syphon for the Los Angeles Department of Water and Power. This syphon, which ranges in diameter from 80 to 94 in. and is being fabricated of from ⅜-in. to 1-1/16-in. plate, is all electric welded. Installation of this huge pipe is being made in Bouquet Canyon, about 50 miles north of Los Angeles.

Following the talk, the group visited the fabricating plant and inspected the equipment for rolling the plate, planing and beveling, tack welding, automatic longitudinal seam welding, testing, etc.

About 110 members and guests of the society attended the meeting and visited the plant, among which were representatives from various local industries, welding students from trade schools and high schools, and engineers and welders from the U. S. Naval fleet at San Pedro.

Makes Articles from Hot-Water Tanks

Flower boxes, hog troughs, and drain pipes made out of discarded hot-water tanks represent a good business for Seth Diehl, proprietor of the City Repair Shop, Hartford City, Ind., who has developed a profitable side line in such items.

Mr. Diehl takes the supply of old hot-water tanks from the local plumbers at a price of 25c to 50c each, and stores these in his shop. During the slow winter season and at other spare times, he converts these tanks into various useful articles.

By cutting off the ends and welding up any side openings, he finds that they are very adaptable as drains under driveways.

For hog troughs, he splits the tank in two and puts legs under each half. He usually gets $2.00 for each trough, making a total of $4.00 for each tank. During the winter season, Mr. Diehl makes at least fifty hog troughs, all of which are sold during the spring and early summer.

For flower boxes, the tanks are usually cut and equipped either with legs or hanging devices, according to the wishes of the individual buyer.

Crime Wave Creates Unusual Welding Job

The recent crime wave in Indiana created an interesting job for P. F. Wagner, job welding shop owner, of Plymouth, Ind. The Marshall County jail in Plymouth has all windows equipped with the usual heavy iron bars with the ends embedded in the walls. While these bars might serve to keep the occupants in the jail, they didn't prevent outsiders from passing files or other tools to the inside.

Mr. Wagner was given the task of making an iron framework covered with heavy wire mesh for each of the 14 windows. Each frame had to be fastened to the outside of the window frame and inside the bars.

The only way to accomplish this was to cut angles to form the frame, pass the pieces through the bars and then weld them together from the outside of the bars, since the frame, if completed first, could not be passed through the bars or through the window from the inside.

After the frame was welded together, it was screwed to the window frame and the screw heads brazed to prevent their removal. Half-inch bars were then welded crossways onto the frame and ¾-in. bars up and down. A screen of heavy wire was then welded onto the frame by spotting it every 2 in. with the torch. The screen is of fine enough mesh to prevent the passing of objects as small as hacksaw blades through the window. The entire job was done by oxyacetylene welding and cutting.

Purdue Announces Program for Conference

The ninth annual conference on welding will be held at Purdue University, Lafayette, Ind., Thursday and Friday, Dec. 7th and 8th, under the direction of the Engineering Extension Department and Department of Practical Mechanics of the University, with the manufacturers and users of welding equipment cooperating. The program is as follows:

Thursday, December 7th

Forenoon

9:00 a.m. Registration in Michael Golden Shops.

Exhibits and Demonstrations.

10:00 a.m. Opening Session—

"Significant Trends in the Application of Welding," by F. L. Spangler, Editor, *The Welding Engineer.*

"Welding Brass and Its Alloys With Gas and Electricity," by W. C. Swift, Service Engineer, The American Brass Co., Waterbury, Conn.

Afternoon

1:00 p.m. Exhibits and Demonstrations.

2:00 p.m. "Special Applications of Welding in Manufacturing Operations," by Fred Carl, Engineer in Process Department, and C. A. Nichols, Assistant Process Engineer, Delco-Remy Corp., Anderson, Ind.

"Oxyacetylene Cutting as an Aid to Welded Design," by Harold Verson, Chief Engineer, Allsteel Press Co., Chicago, Ill.

"Are Welding Fusion Metal," by Robert Notvest, Welding Engineer, J. D. Adams Co., Indianapolis, Ind.

Exhibits and Demonstrations.

Evening

7:00 p.m. Exhibits and Demonstrations.

7:45 p.m. "Metal Spraying"—Talk and Demonstration—by K. D. Falk, Midwest Representative, Metal Spray Co., Chicago, Ill.

Exhibits and Demonstrations.

Friday, December 8th

Forenoon

8:00 a.m. Exhibits and Demonstrations.

9:30 a.m. "Selling the Services of the Job Welding Shop," by W. I. Brockson, Manager Sales Promotion, Steel Sales Corp., Chicago, Ill.

"X-Ray Inspection of Boilers," by G. W. Plinke, Welding Supervisor, Henry Vogt Machine Co., Louisville, Ky.

"Field-Welded Tanks," by H. C. Boardman, Research Engineer, Chicago Bridge & Iron Works, Chicago, Ill.

Afternoon

1:15 p.m. "Recent Developments in Resistance Welding," by J. A. Weiger, Director of Metallurgy, P. R. Mallory Co., Indianapolis, Ind.

"Welding in Plant Rehabilitation," by George Hettrick, President, Anchor Welding Service, Chicago, Ill.

Special Demonstrations (to be announced).

Demonstrations of welding, cutting, brazing, and hard-facing will be given in the shops by various manufacturers of welding equipment and supplies.

Certified Welders Group Holds Meeting

A meeting of the Los Angeles chapter of the Association of Certified Welders was held on the evening of October 26th, and was addressed by Cornelius Cardmo, of Seattle and Bremerton, Wash., organizer and lecturer for the association. The association is making a drive on the Pacific Coast for new members. It is claimed that the organization has a combined active membership of over 500 belonging to chapters in Los Angeles, San Francisco, Oakland, Valejo and Martinez, Calif., and Tacoma, Seattle and Bremerton, Wash. The aim of the organization is to obtain particular recognition for welding as a trade in the field of organized skilled labor.

H. P. Staff, connected with the Los Angeles Bureau of Education, is president of the Los Angeles chapter, and Earl C. Chapman, of Alhambra, is secretary. The association will hold monthly meetings throughout the winter months.

Chicago Section to Hold NRA Program

"The NRA as It Affects the Welding Industry" will be the subject of the meeting of the Chicago Section, American Welding Society, to be held in the Wedgewood Hotel, 64th St. and Woodlawn Ave., Chicago, at 7:30 p.m., Nov. 24th. A dinner at 6:30 will precede the meeting.

The speakers will be F. L. Roberts, District Compliance Director, National Recovery Administration, who will give an outline of the general NRA program, as well as G. L. Drake, sales manager, Harnischfeger Corp., Milwaukee, who will discuss the NRA from the point of view of the manufacturer of electric welding equipment. Efforts are also being made to obtain speakers to represent the manufacturers of welding wire and of oxyacetylene welding and cutting equipment. An open discussion will follow the talks.

Los Angeles Group to See Demonstration on Light

"Recent Advances in Electrical Science" is the subject of the program to be given on the evening of Nov. 23rd by the Los Angeles Section of the American Welding Society. The meeting will be held on the ninth floor of the Chamber of Commerce Building and will be in charge of G. M. Hawley, S. L. Cipperly, and G. M. Rankin, all from the Southern California Edison Co. Actual electrical demonstrations will be given, and an instructive and entertaining time is promised. The topics include such interesting subjects as the "electric eye," invisible light, "black" light, transmission of sound over light beams, light and color, and death rays.

San Antonio High School Starts Welding Courses

When the San Antonio Vocational and Technical High School, San Antonio, Texas, was remodeled recently, a large number of new courses, including one in gas and electric welding, were offered to students. The new welding course, besides affording instruction to regular day pupils, provides for night classes for men who are employed in local industrial plants.

In the space given over to the new welding department, there are ten booths devoted to electric welding. All of these are served by multiple-operator equipment consisting of a General Electric motor-generator set and nine 200-ampere welding control panels. The tenth booth is equipped with an 800-ampere carbon-arc control panel. In order that students may become familiar with single-operator equipment, the school has also purchased a General Electric 200-ampere portable welding set.

New Equipment

Borax-Free Flux for Welding and Brazing

A welding flux has been developed by the Baltimore Paint & Color Works, Inc., Baltimore, Md., that is being recommended for use when welding or brazing cast iron, steel, aluminum, brass, or copper. Among the advantages claimed are that it sticks well to the rod, makes a machinable weld, leaves no glassy, scaly coating, requires a heat only just sufficient to char white pine, is borax-free and won't fly, and in aluminum welding the flux residue can be easily removed with hot water. Trial samples are offered.

Hard-Facing Rod for Aluminum

An aluminum alloy rod for hard-surfacing aluminum, which is said to increase the life of the wearing surface to approximately three times that of the original metal, has been developed by the York Engineering & Supply Co., 1583 Clybourn Ave., Chicago, Ill. The oxide first is removed from the surface by grinding or filing down to bright metal, after which the rod is applied, using a neutral flame from an acetylene torch. The rod adheres readily to the metal at 750° F. It is claimed that no flux is necessary. When the surface is built up to the desired height, the metal can be smoothed down with a steel paddle similar to the method used in puddling aluminum.

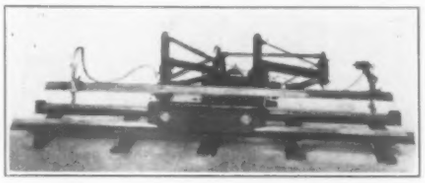
Machine for Straight-Line Cutting With the Torch

For torch-cutting along straight lines, a simple machine has been developed, consisting of a steel channel supporting base, a carriage with a side arm for holding the torch, means for moving the carriage, and means for setting the blowpipe to cut bevels. A motion of 45 in. is possible longitudinally and 7¾ in. laterally. This machine, which is marketed by The Linde Air Products Co., 30 East 42nd St., New York, N. Y., can be furnished with two transverse handwheels for hand operation, or with one handwheel and a 110/115-volt universal motor, either of which can be used simply by throwing a lever.

The carriage is supported by a 3-point suspension, and an automatic catch disengages the carriage from the worm drive when the end of the track is reached. A reverse switch permits motion in either direction.

Travograph Cuts Steel Plates and Slabs

The Air Reduction Sales Co., Lincoln Building, New York, N. Y., recently placed on the market a "Travograph," which embodies an outstanding development in flame-cutting machines. As shown herewith, the mechanism consists



Machine for Cutting Over Large Areas.

essentially of a carriage that supports a pantograph assembly, in addition to suitable driving and control mechanism, a tracing bar carrying a tracing device, and a machine cutting torch. All are mounted on a stationary track. The unit may be employed for cutting large steel plates and slabs requiring cutting over extended areas. In the Travograph, the base as well as the arms travel.

Gas-Engine Mount for Arc Welders

A driving unit for arc welders, consisting of a 6-cylinder Chrysler engine mounted in a steel frame, ready to be adapted to drive any make of electric arc welder by simply attaching the welder in the frame, has been developed by the Welding Engineering Co., 2872 North 41st St., Milwaukee, Wis.

The unit is complete with self-starting equipment, battery, radiator, engine-speed governor, and panel on which is mounted an ammeter, oil-pressure gage, ignition switch, and choke button. A large compartment is provided to hold the welding cable on a reel, with plenty of room for tools, gas welding and cutting apparatus, and working clothes.

This unit can also be furnished complete, with a rebuilt electric arc welder installed.

Trade Literature

"Arc Welding Ordinary Copper by the Hobart Long-Arc Method" is the title of Bulletin D-7, issued by The Hobart Brothers Co., Box U-113, Troy, Ohio. Preparation of the joint and the procedure are described. A table gives the carbon-electrode and filler-rod sizes and the approximate heat for all gages of copper. Instructions are also given on building up friction-bearing surfaces on cast iron and building up on steel, using "Hobronze" rod.

"The Welding of Aluminum" is the subject of a new booklet published by the Aluminum Co. of America, Pittsburgh, Pa., describing the preparation of aluminum and its alloys for welding, and procedure to be used with the various welding processes. Illustrations of work are given. A new booklet is also available on "The Riveting of Aluminum."

The welding of Enduro 4-6% chromium steels is described and the analysis and physical properties of these steels listed in a new booklet by the Republic Steel Corp., Central Alloy Division, Massillon, Ohio. Results are given on weld tests, and the forming, drawing, forging, annealing, and pickling of these steels are discussed.

"A New Nickel Manganese Steel" is the title of an article by John Howe Hall which is available in pamphlet form from The International Nickel Co., Inc., 67 Wall St., New York, N. Y. Several pages are devoted to the use of nickel-manganese rods in welding austenitic manganese steel.

"Procedure Handbook of Arc Welding Design and Practice," recently published by The Lincoln Electric Co., Cleveland, Ohio, is described and illustrated in a folder issued by the company. A table of contents is given, as well as 20 typical questions that are answered in this book.

Engine-driven arc welders of both stationary and portable types are shown and described in Bulletin 3225-A, issued by Schramm, Inc., West Chester, Pa. Included are trailer models of 4-wheel and 2-wheel types, and welders equipped with flanged wheels for railroad service.

"Byers Genuine Wrought Iron Billets" is the subject of a folder citing the advantages of using wrought iron of great uniformity in forging billets. Copies can be obtained from the A. M. Byers Co., Pittsburgh, Pa.

Zinc die castings are being used for a wide variety of articles, according to a bulletin entitled "Planning, Making, Selling—Design for Profits," issued by The New Jersey Zinc Co., 160 Front St., New York, N. Y.

Flexible shafts and equipments are described and illustrated and engineering data given in Catalog No. 26, consisting of 64 pages, recently issued by N. A. Strand & Co., 5001 N. Lincoln St., Chicago, Ill.

The "Metalspray" process of spraying metals, and the equipment used, are described in Bulletin 323, issued by the Metal Spray Co., 113 Llewellyn St., Los Angeles, Calif. A table of capacities is given.

Commercial News

Offers Course in Metal Radiography

A course on metal radiography is to be conducted by the St. John X-Ray Service, Inc., at their laboratory at 30-20 Thomson Ave., Long Island City, N. Y., beginning February 5, 1934. The course will consist of 16 two-hour sessions in the evening from 7:30 to 9:30, there being two sessions each week for a total of 8 weeks. These will include theoretical as well as practical work and will cover all branches of X-ray and gamma-ray inspection of engineering materials, including the examination of castings, both ferrous and non-ferrous, airplane joints, welded pressure vessels, and the like. The fee is $100 per person, which includes the use of equipment and all required materials.

Correction Regarding Arc-Welder Display

The display of a gasoline-driven portable arc welder at the National Metal Exposition held in Detroit the week of October 2nd drew forth the opinion of a writer, in the October issue of *The Welding Engineer,* that it was the first welder of that type to be shown in years. As a correction to this statement, it should be pointed out that the Universal Power Corp., of Cleveland, Ohio, had a V-8 trailer-type 300-ampere gas-engine welder on display at the Metal Show in Buffalo in October of last year.

Rego Announces Prize Winners at Detroit Show

A high-speed welding operation, employed in mass production by The Florence Stove Co., Kankakee, Ill., was carried on continuously at the booth of The Bastian-Blessing Co. at the National Metal Exposition held in Detroit, October 2nd to 6th. Each day one of the new Rego "GX" torches was awarded to the person estimating most correctly the number of pieces turned out daily in the demonstration. Estimates ran from 12 to 179,000 pieces, according to Earl A. Eveleth, who was in charge of the booth. The actual average daily production was around 2,200 pieces.

Winners receiving "GX" torches were: H. J. Kuhlman, Holcroft & Co., Detroit; L. Brown, Dow Chemical Co., Midland, Mich.; F. J. Schlachter, Detroit Edison Co., Detroit; and Ernest Gresehover, Lumber Products Co., Detroit.

Travograph Cuts Steel Plates and Slabs.

The exhibit and demonstration were a singular success, and orders for the new "GX" torch booked at the show indicated a gratifying upturn in renewed purchasing activities, according to Ellsworth L. Mills, vice-president of the company.

The Welding Engineering Co., Milwaukee, Wis., has been appointed Wisconsin distributor for the acetylene generators manufactured by the Sight Feed Generator Co., of West Alexandria, Ohio. E. F. Zuleger has been added to the staff of the Welding Engineering Co. to handle the sales of Sight Feed generators.

The Madison Welding & Supply Co., Madison, Wis., distributors for Airco oxygen and acetylene, recently added carbonic gas (otherwise known as beer gas) to their line of gases, and they report that it fits in very well as an addition to their other gases.

O. B. Schmeltz, formerly of the Putnam Machine Works of Manning, Maxwell & Moore, and more recently connected with The Arch Machinery Co., of Pittsburgh, has become associated with Thomas M. Rees, 18 Fancourt St., Pittsburgh, Pa., in representing the Bryant Machinery & Engineering Co.

Steel and Tubes, Inc., of Cleveland, Ohio, announces that A. V. Grove has been transferred from the Cleveland office to the Chicago office in the sales department. R. E. Doyle is now sales correspondent in the Cleveland office, and J. F. Keeler has been made sales engineer with headquarters in Cleveland.

A. T. Mortrud has been appointed assistant manager of the welding-wire division of Central Steel & Wire Co., Chicago, Ill. Mr. Mortrud has been connected with the welding field for the past ten years, five years of which was spent with Hobart Bros., Troy, Ohio.

Ernest Lunn, consulting engineer, of Chicago, Ill., who for many years has been active in the welding field, has been made vice-president and treasurer of the Condensation Engineering Corp., 132 S. Michigan Ave., Chicago, Ill.

The Muller Brass Co., Port Huron, Mich., has organized a new division known as the Streamline Pipe & Fittings Co. for the purpose of marketing the line of Streamline products made by the parent company.

Robert S. Hale, consultant on the welding of steel structures and the remodeling and reinforcing of existing structures, announces the removal of his office from the Old Colony Building to 1432 W. Lake St., Chicago, Ill.

The Harnischfeger Corp., 4513 W. National Ave., Milwaukee, Wis., have developed a line of portable lighting plants which they are marketing, according to W. Oesterlein, chief electrical engineer.

R. E. Morgan is now connected with the Welders Supply Co., of Oklahoma City, Okla. He was formerly sales manager of the Oklahoma City plant of the Burdette Oxygen Co.

J. B. Tinnon, sales manager of the Metal & Thermit Corp., New York, N. Y., is now in England on business and will return about December 1st.

The National Welding Equipment Co., of Syracuse, N. Y., have moved back to their former location at 517-21 E. Water St.

The Indiana Oxygen Co., Indianapolis, Ind., announces the appointment of J. B. Rogers as sales manager.

Experienced welders appreciate the uniformity of ANACONDA RODS *for gas and electric welding*

- *TOBIN BRONZE** (for gas welding) . . . the original low melting point bronze rod. Widely recognized as ideal for the general oxy-acetylene welding of cast and malleable iron. Saves time and money because of its low melting point—1625°F.
- *EVERDUR** (for gas or electric welding) is a patented alloy of copper, silicon and manganese and has excellent welding characteristics. Makes high-strength welds on copper, brass, bronze and copper-nickel alloys. Also used on thin sheet metal. Melts at 1866°F.
- *ANACONDA MANGANESE BRONZE* (for gas welding) produces a tough, strong bond, unusually resistant to wear. Especially adapted for building up surfaces subject to abrasion. Melts at 1598°F.
- *ANACONDA PHOSPHOR BRONZE* (for gas and electric welding) is extensively used for electrically welding copper, brass, bronze, wrought, malleable and cast iron, low and high carbon steels. Melts at 1922°F.
- *ANACONDA BRAZING METAL* (for gas welding) is a high-zinc brass for welding where strength is not essential. Melts at 1634°F.
- *ANACONDA ELECTROLYTIC COPPER* (for gas welding) is recommended for welding copper where high electrical conductivity is essential. Welds are quite ductile. Melts at 1981°F.
- *ANACONDA SILICON COPPER* (for gas or electric welding) is used to fabricate metal furniture and for other sheet metal work. Requires no flux. Has a good electrical conductivity and makes a strong, sound weld. Melts at 1981°F.

*Trade-marks "Tobin Bronze" and "Everdur" Reg. U. S. Pat. Off.

COPPER ALLOY welding rods . . . because of their strength and low melting points . . . are extensively used for welding iron, steel, copper and copper alloys by both the oxy-acetylene and carbon or metal arc methods. The consistently high quality of Anaconda Rods explains their popularity with thousands of satisfied users who will accept no other brand of copper alloy welding rods.

Each of the seven different Anaconda Welding Rods listed at the left has its individual characteristics . . . and each is particularly adapted to certain types of work. Most widely used is Tobin Bronze . . . because of its acceptance as the ideal rod for the general oxy-acetylene welding of cast or malleable iron. With Tobin Bronze, which melts at 1625°F., preheating is usually unnecessary.

The uniform composition and unvarying high quality of all Anaconda Welding Rods are due to the experience and technical knowledge of The American Brass Company—extreme care being exercised to prevent the inclusion of even the minutest quantities of undesirable impurities. All are available through leading distributors of welding supplies . . . usually shipped in bulk, but also obtainable in clearly labeled ten-pound packages. And all are described in Anaconda Publication B-13, mailed on request.

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ANACONDA WELDING RODS

News From the Field

Finds Demand for Carbide Sludge

The disposal of carbide sludge is no problem to the Liability Welding Co., of Fort Wayne, Ind., according to Guy Bennet, one of the partners. The shop uses a 300-lb. Oxweld acetylene generator from which there is drained off 300 gallons of sludge every time the generator is charged. Few cities permit the disposal of this sludge through the city sewerage system, so its disposal in some plants is quite a problem.

Knowing that this sludge makes the best of whitewash, this shop drains the generator into a pit where the water can evaporate as well as seep away, leaving a residue of slacked carbide. Though this generator has been in use but a short time, the word has spread throughout the community about this sludge pit, and people come there with wagons, pails and cans and carry the sludge away. The demand for the sludge is greater than the supply, so the pit is always empty whenever it is time to drain the generator.

Farmers Ask for Hard-Facing After Visit at Fair

Five farmers in his vicinity who have viewed at different times the stellite demonstration at A Century of Progress in Chicago, have brought plow shares into his shop to be Stellited on the strength of what they saw at the demonstration, states Wm. J. Volpert, proprietor of Volpert's Welding Shop, at Peru, Ind.

Mr. Volpert really merchandises hard-facing. In many cases he sharpens one share and hard-faces one for a farmer and only charges for sharpening. Then he asks his customers to compare the two shares in acres plowed, and invariably they come back for hard-facing.

He also gets business from newspaper advertising. He recently inserted an ad in the county paper, in which he featured the long life of Stellited plow shares. The ad resulted in two new customers, so it paid for itself and kept the name of the shop before the residents of the community.

Uses a Magneto as a Torch-Lighter

A magneto makes a good torch-lighter, in the opinion of T. H. Jungenberg, proprietor of Ted's Welding Shop, Mt. Horeb, Wis., who has one mounted on the corner of his welding table. He turns the magneto crank and a spark jumps across the spark gap, igniting the gas issuing from the tip end of the torch. The device works quickly and is always ready. For jobs requiring frequent relighting of the torch, Mr. Jungenberg uses a small oil can filled with oil and equipped with a wick.

Welding Shop Acquires Wide Reputation

A welding shop that is aggressive and well-equipped will continue to forge ahead even in times of unfavorable business conditions, as witness The Flour City Oxwelding Co., of Minneapolis, Minn., of which G. V. Watson is manager. Mr. Watson employs only thoroughly experienced welders, and his reputation has spread over a wide area. He

Portable Arc-Welding Unit Used by Minneapolis Shop.

recently completed a bridge job at Holliday, N. Dak., more than 600 miles from Minneapolis, which lasted approximately six weeks. The company has one of the finest and most attractive portable arc-welding units ever seen. This field unit also carries gas-welding equipment, as well as a special gasoline tank which will hold a 3-days' supply of gasoline for the arc welder.

Fly-Wheel-Tooth Repair Specialists Hold Meeting

A. G. Quigley, manager of the Williamson Welding Works branch at Sacramento, Calif., has returned from a convention of managers of the twenty-six branches of the firm in Carpinteria. Mr. Quigley reports that with a new record of 811,348 flywheel teeth installed this past year, this industry shows a steady upward curve. Each auto patient averaged forty-one teeth that had been knocked out by back-firing and other causes.

Manufacturer of Saws Adds Welding Equipment

The Northwestern Saw Works, of Aberdeen, Wash., the largest independent saw producing plant of the Northwest, has made a number of additions to the plant to take care of increase in business in the various departments. They have installed atomic-hydrogen welding equipment to handle repair work for all types of saws and mill equipment. The company plans to push sales to all mills in Oregon and Washington. W. M. Gill, formerly of Tacoma, has been named general sales manager. Phil J. DeLorme heads the company.

J. M. Huntington's welding shop at 1442 Foothill Blvd., in La Canada, Calif., was recently enlarged and moved back several feet to make way for widening of the boulevard in La Canada. An attractive front as well as additional working space is a result of the change. Also, all shop equipment was rearranged and reset, providing additional convenience and efficiency. Mr. Huntington has been in business at this location for the past nineteen years, and has a wide and well-deserved reputation for expert welding and blacksmithing. He also features ornamental iron work, including wrought-iron fancy art work, hand-forged antique hardware, etc.

The Allen-Randall Welding Co., 316 Jay St., LaCrosse, Wis., has purchased a rebuilt 200-ampere motor-generator-type welder with a shaft extension coupled to a 6-cylinder Chrysler engine. The coupling is easily disconnected when it is desired to drive the generator by the electric motor. The entire unit is mounted on a 4-wheel trailer, with pneumatic tires, and is covered with a sheet-metal housing, which keeps the elements out and contains a compartment for welding cables, equipment, and clothing. The unit was purchased from the Welding Engineering Co., Milwaukee, Wis.

When welding with the arc, a folding metal screen is used by C. E. Nelson to surround him and the work in the welding department of the Colver Machine & Iron Works, Frankfort, Ind. Even this, however, does not keep the curious from peeking and getting a pair of burnt eyes. So Mr. Nelson is going to put a large piece of welding glass in one side of the screen with a sign reading "Look Here."

A contract for welding a partition into each of 131 cars built for a narrow-gage rail track was recently completed by the Goody Bros. Boiler Co., of Kokomo, Ind. The cars are used to haul cement and dry mix, the two being separated by the welded partition. Each car required an average of 28 ft. of welding. Fleetweld and G-E speed-rod were used.

John S. Beall, president and treasurer of the Beall Pipe & Tank Corp., died at the Portland, Ore., General Hospital on

October 24th after a brief illness. He was 66 years of age. Some twenty years ago Mr. Beall organized the Coast Culvert & Flume Co., the predecessor of the present company. At one time he was also interested in culvert-pipe companies in Spokane, Wash., and Missoula, Mont.

The Southern California Welding Trade Association, the organization of which was announced in the September issue of *The Welding Engineer*, is to have an early meeting with the organization of Northern California, having headquarters in San Francisco. The meeting is planned for Sacramento with the expectation of forming a state-wide organization.

C. E. Nelson, of Frankfort, Ind., received first prize for wrought-iron work displayed at the Indiana State Fair at Indianapolis. This honor has gone to him every year since the wrought-iron section was installed at the Fair. Mr. Nelson uses considerable welding in his ornamental iron work.

The Southwest Welding & Manufacturing Co., of Alhambra, Calif., announce that they will soon build an addition to their plant at 3201 Mission St. The building will be of welded structural steel and the roof and sides will be of corrugated iron.

A great amount of welding will soon be under way by the Golden West Brewing Co., of Oakland, Calif., which concern is preparing plans for the construction of a large brewery to be erected at 11th and Soto Sts. in Los Angeles.

The Y. M. C. A. at Indianapolis, Ind., have opened their fall welding course under the instruction of R. W. Pursel, of the Indianapolis Power & Light Co. Both arc welding and oxyacetylene welding are taught.

The two night classes in the welding department of the Frank Wiggins Trade School in Los Angeles, Calif., have a total enrollment of about fifty students, which is larger than the usual fall enrollment.

L. W. Schultz, proprietor of the Electric Welding Shop, Decatur, Ind., is renting additional space, so his shop now has twice as much floor space as formerly.

Carl Marxman, job welding shop owner of Rochelle, Ill., has applied for a patent on the application of arc welding to corn husker snapping rolls.

H. S. McCurdy, formerly of the M & M Welding Service, Waukegan, Ill., is now with the Botts Welding Service, at Woodstock, Ill.

The Blackhawk Welding Co., Rockford, Ill., are developing and planning to market a line of welded ornamental-iron fixtures.

The Pacific Welding & Repair Shop, in Hynes, Calif., was recently moved from its old location to 112 S. Paramount Blvd.

Yocums Garage, DeKalb, Ill., have added a 200-ampere Todd arc welder with gas-engine drive.

· CLASSIFIED ADS ·

Help Wanted—75c per line, minimum 4 lines. Jobs Wanted—4 lines free. Other Ads—$1.00 per line, minimum 4 lines. Count 8 words to line. Add 6 words for keyed address.

WANTED TO BUY

Wanted to Buy—1000 oxygen cylinders and 1000 acetylene cylinders. Must be gov't inspected and guaranteed, both 110 and 220 cu. ft. sizes. Also want several used 200-ampere arc welders. Address Box 124, The Welding Engineer.

Wanted to Buy—General repair and welding shop in city of three to fifty thousand population, good surrounding farming community; central or southern states; must show profitable business. Frank M. Burr, Standish, Mich.

FOR SALE

For Sale—Several 200 and 400 ampere Hansen gas-engine welders; reasonable. Two Lincoln 150-ampere electric motor-driven welders at $150 each. All rebuilt. Address Box 123, The Welding Engineer.

Bargains—Demonstrator Arc Welders. Gasoline, electric drive, belted, or coupled-together outfits. 30 days' trial. Easy terms, if desired. Write Ken's Welding Exchange, Box U-1131, Troy, Ohio.

For Sale—Metal Coating Outfit complete. 2 Metallizer guns, cabinets, blowers, compressor and sand-blasting room. Like new. Can be seen working. Standard Welding & Spring Co., Inc., 746-48 Communipaw Ave., Jersey City, N. J.

Standardized Cutting and Welding Tips, interchangeable with various types of torches; also apparatus, accessories and complete outfits. Priced right. High quality and workmanship. Write for catalog. The Alexander Milburn Company selling on behalf of TIPS, INC., 1416-18 W. Baltimore St., Baltimore, Maryland.

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Representatives Wanted—To sell welding and brazing fluxes to dealers, shops and industries. A moderate priced, long commission line of proven satisfaction. Baltimore Paint & Color Works, Inc., Baltimore, Md.

Wanted—Welding Engineer to take complete charge shop and field engineering operations, make time studies, run tests, assume responsibility, proper upkeep machines. Young man, technical training, some welding experience, energetic, truthful, capable of taking orders and likewise seeing his own carried out. Give full particulars, salary, references, etc., first communication. Address Box 122, The Welding Engineer.

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Layerout—Experienced on riveted and welded plate and structural work, desires employment. Is competent draftsman and estimator. Address Box 121, The Welding Engineer.

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STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.

Of The Welding Engineer, published monthly at Chicago, Illinois, for October 1, 1933.

State of Illinois, County of Cook, ss.

Before me, a Notary Public, in and for the State and county aforesaid, personally appeared F. L. Spangler, who, having been duly sworn according to law, deposes and says that he is the Editor of The Welding Engineer, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, G. H. Mackenzie, Chicago, Illinois; Editor, F. L. Spangler, Chicago, Illinois; Managing Editor, None; Business Manager, F. L. Spangler, Chicago, Illinois.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) The Welding Engineer Publishing Co., 608 S. Dearborn St., Chicago, Ill.; G. H. Mackenzie, 7321 So Shore Drive, Chicago, Ill.; H. S. Card, 11 Woodrow Ave., Haverhill, Mass.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

F. L. SPANGLER, Editor.

Sworn to and subscribed before me this 28th day of September, 1933 (Seal.) S. N. Levin.

(My commission expires January 16, 1936.)